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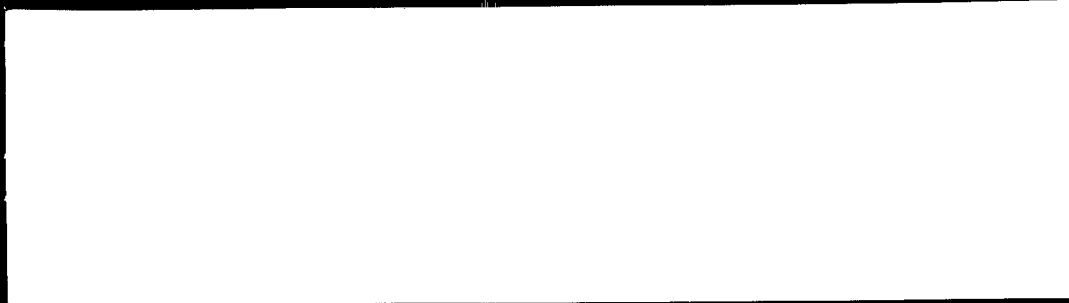
  

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**Final Work Implementation Plan  
PRDA Test: "Fluidized Bed Adsorption"  
McClellan Air Force Base, Site IC 31  
Sacramento, California**

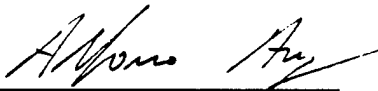
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**McClellan Air Force Base  
Sacramento, California  
Contract No. F04699-97-C-0102**

HLA Project No. 37478 14



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**Final Work Implementation Plan  
PRDA Test: "Fluidized Bed Adsorption"  
McClellan Air Force Base, Site IC 31  
Sacramento, California**

**HLA Project No. 37478 14**

This document was prepared by Harding Lawson Associates (HLA) at the direction of the McClellan Air Force Base (McClellan AFB) for the sole use of McClellan AFB and the regulatory agencies overseeing the McClellan AFB Installation Restoration Program, the only intended beneficiaries of this work. No other party should rely on the information contained herein without the prior written consent of McClellan AFB and HLA. This report and the interpretations, conclusions, and recommendations contained within are based in part on information presented in other documents that are cited in the text and listed in the references. Therefore, this report is subject to the limitations and qualifications presented in the referenced documents.

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## **DISTRIBUTION**

## 1.0 INTRODUCTION AND BACKGROUND

This Final Work Implementation Plan (WIP) describes the planned activities and procedures for a Fluidized Bed Adsorption (FBA)<sup>1</sup> performance test under a Program Research and Development Announcement (PRDA) at McClellan Air Force Base (McClellan AFB), Sacramento, California. This document presents the test objectives, test procedures, sampling and analytical methods, quality assurance/quality control (QA/QC) procedures, and health and safety issues related to the PRDA test. This document addresses comments to the draft WIP as identified in the Response to Comments table, Appendix E.

### 1.1 Program Overview

McClellan Air Force Base is researching innovative technologies in an effort to identify cost-efficient remediation approaches. Technologies that prove viable at McClellan AFB may be applicable at other military bases that have conducted similar operations involving the use, storage, and disposal of hazardous materials such as industrial solvents, electroplating chemicals, and a variety of fuel, oils, and lubricants.

### 1.2 Technology Need

Since 1979, soil and groundwater contamination has been investigated at McClellan AFB and remediation is in progress at several sites on base. Volatile organic compounds (VOCs) constitute the most widespread and common subsurface contaminants at McClellan AFB, including: trichloroethene (TCE), tetrachloroethene (PCE), 1,1-dichloroethene (1,1-DCE), 1,1,1-trichloroethane (1,1,1-TCA), and Freon<sup>®</sup> 113.

McClellan AFB developed the PRDA with a stated research interest in innovative technologies to remediate chlorinated hydrocarbons in either groundwater, soil, or air. Soil vapor extraction (SVE) is one of the technologies in widespread use at McClellan AFB to remove VOCs from soil. These systems generate air streams which require emissions control, which is the focus of this test. McClellan AFB's basic intent in pursuit of innovative technologies for emissions control is to identify and develop technologies that will provide the following:

- VOC destruction and removal efficiency (DRE) that meets or exceeds Best Available Control Technology (BACT) criteria, and Sacramento Metropolitan Air Quality Management District (SMAQMD) requirements
- Low or no generation of by-products that require further handling/disposal
- Low nitrogen oxides (NOx) and priority pollutants emissions
- Relatively lower capital and operation and maintenance (O&M) costs (as compared to treatment methods currently in use such as catalytic oxidation/carbon adsorption)
- Modular design to allow easy transfer of equipment between various soil vapor extraction (SVE) sites.

<sup>1</sup> The term "Fluidized Bed Adsorption" has been used by the vendor for this equipment in trade literature; the reference to "fluidized bed" is intended to distinguish this technology from "static bed" adsorption technologies and is not intended to imply a certain particle path within the reactor.

**1.3 Purpose**

Fluidized Bed Adsorption (FBA) has been identified as an innovative technology that may meet the above stated PRDA requirements for treatment of extracted soil vapor. Performance testing of this technology will be conducted using a slip stream from the existing soil vapor extraction (SVE) system located at Investigative Cluster 31 (IC 31; Plate 1). The purpose of the proposed FBA Test is to evaluate the ability of FBA to fulfill the PRDA objectives (Section 4). If testing is successful, HLA and McClellan AFB, will evaluate potential applications of FBA at other sites.

The WIP is structured in accordance with the outline template for all National Engineering Technology Test Sites (NETTS, *McClellan AFB 1997*) and presents the implementation plan for the FBA Test. In addition, the WIP includes the following support documentation required by Contract No. F04699-97-C-0102:

- A site-specific health and safety plan in accordance with OSHA Publication 1910.120; AFOSH Publication 161-21; and U.S. Army Corps of Engineers Safety and Health Requirements Manual EM-385-1-1 (Section 9 and Appendix B)
- A Hazardous Waste Management Plan (Section 5.4)
- A Sampling and Analyses Plan (Section 7.0)
- A Quality Assurance Project Plan (Section 8.0).

## 2.0 SITE DESCRIPTION

### 2.1 Site Location and History

McClellan AFB has selected Site IC 31, between Magpie Creek and McClellan AFB Building No. 352, to test FBA. McClellan AFB operates a catalytic oxidizer (cat-ox) at the site that treats vapor-phase contaminants from the following sources:

- Vadose zone soil vapors from existing extraction well VW-5001
- Air emissions from an air stripper that currently treats groundwater at the site.

McClellan AFB has constructed a concrete pad to accommodate technology demonstration projects. The test equipment pad is adjacent to the SVE, cat-ox, and groundwater treatment equipment with power, tap water, and McClellan AFB sewer connections available.

### 2.2 Geology

Reserved.

### 2.3 Hydrogeology

Reserved.

### 2.4 Contaminant Distribution

Table 1 summarizes the chemicals of concern observed in vapors from VW-5001 and the air stripper at Site IC 31 based on a review of data provided by McClellan AFB (Appendix A). Both chlorinated and non-chlorinated hydrocarbons have been observed in vapors extracted at IC 31.

The chlorinated VOCs, typically related to solvent releases, include TCE; 1,1-DCE; 1,1,1-TCA; carbon tetrachloride, and Freon<sup>®</sup> 113. These chlorinated VOCs are highly volatile under ambient conditions and are readily recovered by SVE. TCE concentrations at extraction well VW-5001 have decreased from a maximum concentration of 1,500 parts per million by volume (ppmv) to 70 ppmv during the fourth quarter of 1996. TCE is typically observed at concentrations that are an order of magnitude greater than the other chlorinated VOCs; 1,1-DCE provides the second-most significant mass contribution.

The non-chlorinated VOCs are a mixture of straight-chain hydrocarbons and aromatic hydrocarbons such as benzene, toluene, ethyl benzene, and xylenes (BTEX). Site data provided by McClellan AFB (Appendix A) includes an estimate of the total mass of hydrocarbons in VW-5001 vapors (October 28, 1996) expressed as 3,258 ppmv Total Volatile Hydrocarbon Mass (TVH); speciated results showed 1,500 ppmv TCE in the same sample. A review of the available TVH mass calculations indicate that more than half of the hydrocarbon constituents entering the cat-ox system are typically estimated to fall in the gas chromatograph (GC) range of pentane to octane (C<sub>5</sub> to C<sub>8</sub>); lighter hydrocarbons (propane and butane, C<sub>3</sub> to C<sub>4</sub>) and semi-volatile hydrocarbons (decane and above, C<sub>10</sub>+) are observed at concentrations that are

- 1 generally an order of magnitude lower than the C<sub>5</sub> to C<sub>8</sub> range. Appendix A also includes results for
- 2 non-methane organic compounds (NMOCs) quantified as methane, a comparative value that is calculated
- 3 assuming all of the hydrocarbons detected in the sample are methane, providing a consistent means of
- 4 quantifying a diverse mixture of fuel hydrocarbons. NMOCs decreased from 68,000 ppmv to 12,000 ppmv
- 5 during the fourth quarter of 1996.



### 3.0 TECHNOLOGY DESCRIPTION

The fluidized-bed adsorption process is designed to capture and recover a wide variety of both chlorinated and nonchlorinated VOCs, many of which are commonly found at industrial and military sites. The technology has been successfully applied historically to a wide variety of industrial process applications. It is now being developed for use in the site remediation field. This presents several challenges due to the variability of both the type and concentration of VOCs present in extracted soil vapor.

#### 3.1 Principles of Technology

FBA technology concentrates VOCs from vapor-phase constituents in air streams into liquid-phase product. The process uses adsorptive media to remove VOCs from the air stream, continuously regenerates the adsorptive media with heat, and recovers the VOCs as a liquid-phase product typically suitable for recycling.

The main components of the FBA System (FBAS) include:

- Fluidized bed adsorber
- Moving bed desorber with a heat source
- Solvent condenser with liquid-chiller refrigeration.

An FBAS is coupled with a vacuum blower, moisture separator, and air filter to comprise a complete soil vapor extraction (SVE) system with off gas treatment, as shown on the process flow diagram (Plate 2). For the FBA Test configuration at IC 31, the 100-cfm test equipment (FBA test unit) will treat soil vapors using a slip stream from the existing SVE system.

#### 3.1.1 Adsorption Column

The air stream containing solvent vapors is treated continuously through the fluidized-bed adsorption column (adsorber). In the adsorber, the solvent vapors are removed from the process gas by adsorption onto the solid adsorption medium (Ambersorb® 600 manufactured by Rohm and Haas Company) which flows across a series of perforated trays in the adsorber tower. The air stream travels upward through the adsorber tower and passes through several trays of adsorbent media. Regenerated adsorbent is continuously loaded at the top of the tower and travels downward through a series of "downcomers." The arrangement is similar to that used in air strippers and distillation towers. The adsorbent media acts like a liquid (hence the term "fluidized") because of the lifting action of the air stream traveling upward through perforations in the trays. The adsorbent becomes progressively more loaded with VOCs as it travels down the tower until it reaches the bottom of the tower and is removed for regeneration.

#### 3.1.2 Desorption Column

The resin with adsorbed VOCs (loaded beads) is transported from the bottom of the adsorber to the top of the moving bed desorption column (desorber) by pneumatic lift. The desorber operates as a moving bed and regenerates the resin by heating with a non-contact steam or recirculating hot oil. Heat causes the VOCs on the loaded beads to return to the vapor phase where they are removed from the top of the desorber by a small, constant stream of purge gas (nitrogen) which is injected at the bottom of the

desorber. Before leaving the desorber, the resin is cooled to near ambient temperature by a non-contact cooling water stream. The regenerated beads are then returned to the top of the adsorber.

### 3.1.3 Product Condensation

The hot stream of purge gas, which has a high concentration of VOCs, is transported to a two-stage solvent condenser. In the first stage of the condenser, a high temperature coolant or cooling water is used to condense high boiling point liquid solvents, (i.e., xylene) which could freeze in the second, refrigerated condenser. In the second stage condenser, the low boiling point liquid solvents are condensed. The discharge from both stages of condenser is directed to a solvent recovery drum. The remaining carrier gas is recycled back into the adsorber where any remaining solvent is processed through the adsorber.

### 3.1.4 Product Recycling

Recovered liquid product is contained in DOT-approved drums for transportation to a licensed recycling facility. The product becomes the property of the recycling facility, which will recover the various constituents as a recycled solvent or blend the product into heating fuel for use in cement kiln furnaces.

## 3.2 Technology Applicability

FBA is suitable for capture and recovery of a wide variety of both chlorinated and nonchlorinated VOCs. The FBA desorber and chiller design temperatures determine the range of VOCs that can be treated. Relatively volatile compounds, such as solvents, are the most applicable targets for FBA because the resin beads can be regenerated at relatively low temperatures with corresponding low energy needs. The following compounds are typically treatable with FBA using a steam-heated desorber operating at 300° F:

perchloroethylene	chlorobenzene
trichloroethene	dichlorobenzene
methyl ethyl ketone	benzene
methylene chloride	ethyl benzene
carbon tetrachloride	toluene
1,1,1-trichloroethane	xylene (o-, m-, and p-)
acetone	Freon® 113
chloroform	

The FBA test unit is being modified for the IC 31 test to use an oil-heated desorber operating at a maximum temperature of 450°F. This experimental modification has been made to improve the FBA test unit's ability to desorb semi-volatile organic compounds (SOCs) that have boiling points in excess of 300°F, such as decane and other fuel hydrocarbons with carbon numbers equal or greater than C<sub>10</sub>.

## 3.3 Advantages and Limitations of Technology

### 3.3.1 Advantages

The fluid-bed process offers a number of advantages over other available, leading treatment technologies. FBAS does not destroy the solvents but recovers them so that they can be recycled. Relative to fixed bed regeneration systems, the fluid-bed adsorber has less pressure drop through the adsorbent and, therefore, requires less energy to move the organic vapors through the system. Additionally, less energy is used in the regeneration process in that the desorber remains heated at the desorbing temperature via a recirculating hot oil system or steam generator. Because the desorber remains at a constant temperature,

energy is not wasted heating and cooling the entire desorber vessel as with fixed-bed systems. In the fluid-bed system, only the adsorbent media cycles thermally as it moves from the desorber to the adsorber and back again. This lack of thermal cycling of the desorber vessel also reduces the potential from metal stress and fatigue which can lead to favored sites for corrosion attacks. Lower pressure drop in the adsorber and lack of thermal cycling in the desorber translate to lower operating costs and better corrosion resistance. Finally, since a condensation process rather than an oxidation process is used to remove the VOCs from the purge gas, corrosive oxidation byproducts are insignificant and NOx and SOx emissions are not generated.

### 3.3.2 Limitations

Temperature settings in the desorber and solvent condensers are selected based on the type of VOCs present in the process stream. Three classes of compounds cause potential difficulties with the treatment process: high boilers, low boilers, and compounds with high freezing points. Each of these classes of compounds can be addressed by adjusting the design temperature setting for the desorber or condensers.

High boilers are compounds with boiling points at or above the temperature of the FBA desorber where VOCs are evaporated into vapor-phase from the loaded beads. These compounds remain adsorbed to adsorbent media indefinitely and, as the resin continues to cycle through contaminated SVE stream, accumulate on the adsorbent media. The presence of such compounds ultimately saturate the adsorption sites on the media, resulting in decreased removal efficiencies for all VOCs being treated. Steam-heated desorbers are impacted by compounds that boil at more than 300°F, such as decane. Oil-heated desorbers achieve higher temperatures (up to 450°F) and can accept a wider range of high-boiling VOCs; however, operating the desorber at higher temperatures increases the FBA system energy needs.

Low boilers are compounds with boiling points at or below the temperature of the FBA condensers where the vapor-phase VOCs are condensed into liquid-phase. These compounds, such as chloromethane, if not condensed, are returned to the FBA adsorber with nitrogen off-gas and are emitted to the atmosphere rather than recovered as liquid product. This condition results in lower capture efficiency of low boilers compared to less volatile compounds.

High freezers are compounds that exhibit freezing points above the temperature of the FBA condenser where vapor-phase VOCs are condensed to liquid-phase product. These compounds freeze into solid-phase and can clog the condenser. During previous testing, xylene was the primary chemical that caused clogging (Paragon, 1995).

The potential difficulties associated with both low boilers and high freezers are addressed using a two-stage condenser design. This allows high freezers to be condensed and separated as liquid before condensing the low boilers into a liquid-phase at a lower temperature.

In addition to these classes of compounds, chlorinated organics can breakdown during desorption and form acid gases due to uneven heat transfer. When electrical heaters are used to regenerate adsorption beads, very large thermal gradients are generated at the surface of the electric heaters. In the presence of oxygen, this hot spot may cause degradation of the chlorinated compounds and generate acid gases. Solvent degradation is minimized by using evenly distributed heat sources, such as steam or hot oil, and an inert purge gas, such as nitrogen.

### 3.4 Development Status

HLA and Paragon, to our knowledge, operated the first field-scale FBAS on a SVE application in the United States. The system was operated at the National Semiconductor Corporation (National) facility in Santa Clara, California. The successful extended pilot study treated a soil vapor extraction offgas stream containing a mixture of chlorinated and nonchlorinated VOCs (Paragon, 1995). Two full-scale treatment systems have subsequently constructed and are currently under operation at the site.

Pilot-test results indicate that the unit achieved a total nonmethane hydrocarbon (NMHC) removal efficiency of 86 to 95.9 percent. The inlet stream consisted of 100 standard cubic feet per minute (scfm) air with a mixture of xylenes, ethylbenzene, trichloroethylene (TCE), perchloroethylene (PCE), Freon<sup>®</sup> 113, acetone, carbon tetrachloride, 1,4-dichlorobenzene, 1,2 dichlorobenzene, and 1,1,1 trichloroethane. Purge gas was supplied from an in-house nitrogen supply. Condensers were operated using an in-house chilled water source. Desorption heat was supplied by a steam generator.

Based on our review of data provided by McClellan AFB, sites impacted by solvents are also typically impacted by fuel constituents. At the test site, Investigation Cluster 31 (IC 31), solvents are mixed with fuel constituents, such as decane, that are likely to have boiling points that exceed 300° F, the desorption temperature achieved with low-pressure steam. As a result, HLA has modified the FBA test unit to incorporate a 450° F hot-oil desorber to treat high-boiling hydrocarbons and a second-stage chiller to treat low boilers and high freezers. Conditions at IC 31 will provide data on how well FBA operates with a significant portion of the influent stream consisting of high-boiler fuel constituents, as would be characteristic of remediation projects at other military facilities.

## 4.0 OBJECTIVES

### 4.1 General Overview

To be a valuable undertaking for McClellan AFB, the project objectives must be consistent with the overall program goals for McClellan AFB. The Installation Restoration Program (IRP) protects human health and the environment by cleaning up hazardous waste contamination while optimizing IRP resources and satisfying the various stakeholders.

The project objectives have been developed to demonstrate the capability of fluidized bed adsorption at McClellan AFB Site IC 31. The project will test system performance during a field application exhibiting a wide variety of chemical constituents at varying concentrations.

### 4.2 Test Objectives

HLA and McClellan AFB have developed three key objectives for the project, as defined by the Performance Work Statement (PWS, McClellan AFB 1996b) for this PRDA contract: 1) demonstrate innovativeness, importance, and relevancy; 2) illustrate cost effectiveness, and 3) quantify the extent of mass removed.

#### 4.2.1 Objective 1 - Demonstrate Innovativeness, Importance, and Relevancy

HLA will seek to demonstrate the innovativeness, importance, and relevancy of FBA by achieving the following during the test:

- Non-corrosive emissions
- Negligible NOx emissions
- Product recycling rather than waste generation and disposal
- Reduced energy use and input materials relative to comparable technologies.

#### 4.2.2 Objective 2 - Evaluate Cost Effectiveness

HLA will collect data representative of typical system operation to support a cost analyses of FBA for the full life-cycle of a soil vapor extraction project (i.e., treating high concentrations at startup and low concentrations as operations mature).

#### 4.2.3 Objective 3 - Quantify Mass Removal

HLA will seek to demonstrate acceptable VOC mass removal capabilities during the test by evaluating the ability of FBA to achieve:

- Best Available Control Technology (BACT) treatment criteria of 95 percent or greater destruction and removal efficiency (DRE) for mixed streams of chlorinated and nonchlorinated hydrocarbons
- Ninety percent operational time after startup and shakedown

- Satisfactory adsorption and desorption of high boiling point compounds with the recently modified hot-oil desorber.

### **4.3 Test Plan**

This section presents a summary of the test plan, including the main elements of the test that will contribute to achieving the objectives, and the general monitoring requirements to assess these elements. Section 4.4 summarizes how monitoring data will be evaluated to assess performance versus objectives. Field activities are further described in Sections 5.0 and 7.0. Field work will be performed in accordance with the Quality Assurance Project Plan (Section 8.0) and the Site-Specific Health and Safety Plan (HASP), attached in Appendix B and cross-referenced with NETTS format in Section 9.0.

FBA testing will be conducted on a slip stream (90 to 110 cfm) from the existing SVE system at Site IC 31. The Process Flow Diagram (Plate 2) illustrates the incorporation of the FBA test unit into the existing SVE system. HLA will provide the FBA test unit and an auxiliary positive displacement (PD) blower. After start-up and shakedown, testing will be conducted at higher concentrations near the capacity of the test unit for six weeks. This will be followed by three weeks of testing at lower concentrations to simulate late term SVE operation.

#### **4.3.1 Demonstrate Innovativeness, Importance, and Relevancy**

Non-Corrosive Emissions - Corrosion resulting from the system offgases, which is not expected to be significant, will be measured with a CORROSOMETER®, an electrical resistance corrosion probe that is placed inside the discharge stack where maximum sensitivity to corrosion rate changes are expected. Corrosion is monitored by measuring the mass of the probe every 6 hours (more frequently if data logging capacity is available), which is recorded in a data logger to provide a corrosion time history over the entire project life.

Negligible NO<sub>x</sub> Emissions - An air emission sample will be collected from the FBA test unit stack and chemically analyzed on site for the presence of nitrogen oxides (NO<sub>x</sub>); sulfur oxides (SO<sub>x</sub>) will not be monitored due to the lack of sulphur in existing site data. The sample will be collected during the first phase of the test, when the FBA test unit is treating high influent VOC concentrations.

Product Recycling - Product recycling will be implemented rather than waste disposal. Condensed liquid product will be sampled and submitted to a laboratory for analyses using EPA Test Method 8240 to quantify the type and distribution of VOCs and water content, if possible. The samples will also be analyzed by the recycling facility, Romic Environmental Services (Romic), for total dissolved solids, total suspended solids, and chloride content to classify the product's fuel grade characteristics. Product will be managed as described in Section 5.4.

Reduced Energy Use - Power utilization (i.e., current draw during normal operations) will be measured at the beginning of each phase of testing at the site; once during treatment of high influent VOC concentrations and again during the treatment of low concentrations.

#### **4.3.2 Collect Cost Data**

Operating costs and parameters will be documented during each of the two test periods, the first at high concentrations and a second at low concentrations. Field labor hours, materials, utility usage, and recycling operations will be tracked during each phase of the test on the Operation, Maintenance, and Shutdown Log (Table 2).

### 4.3.3 Quantify Extent of Mass Removal

BACT Treatment Criteria - The mass of constituents entering and exiting the FBA system will be monitored to provide data for mass balance calculations by collecting and analyzing samples of FBA influent vapors and effluent emissions. The composition and mass of liquid product and water recovered from the FBA test will also be estimated by measuring the volume of each separate phase, if discernible, in the condensate collection containers. If separate phases are present, the volume of each will be calculated based on a product/water interface measured with an interface probe. Samples will be collected and analyzed to estimate the distribution of liquid-phase VOCs recovered during the FBA Test.

Ninety Percent Operation Time - Operating status will be documented throughout the various stages of operation to show that the fluidized-bed adsorption units can achieve more than 90 percent operation time after startup and until the completion of the pilot test. During each site visit, the field technician will estimate and record the amount of operating time since the previous field visit. Cumulative downtime will be documented and categorized as isolated occurrences, unrelated to system performance, or disruptions that are inherent to the technology.

Satisfactory SOC Adsorption/Desorption - In addition to the influent/effluent vapor samples, resin bead samples from the FBA test unit desorber and adsorber will be collected and analyzed using extraction techniques designed to recover SOC's that may accumulate on the resin over time if not completely removed in the desorber.

### 4.4 Data Analysis and Interpretation

Data collected during the test will be checked for compliance with quality control requirements prior to use in analyses and evaluation stages of this evaluation. Valid data, operational logs, and other information will be compiled and analyzed to assess performance relative to the objectives of this test.

#### 4.4.1 Analyze Innovativeness, Importance, and Relevancy

Non-corrosive Emissions - The corrosion probe mass will be plotted versus time to show a real-time representation of corrosion that may have occurred during the test. Cross-referencing periods of time where accelerated corrosion rates occurred with the sequence of system operations will provide a diagnostic tool to analyze whether certain operations increase or inhibit corrosion.

Negligible NO<sub>x</sub> Emissions - Chemical analyses results will be reported for NO<sub>x</sub> observed in an emissions sample from the FBA test unit. The mass of NO<sub>x</sub> will be extrapolated to estimate an expected yearly discharge mass.

Product Recycling - Product recycling implemented during the test will be reported. Chemical analyses results will be compiled and these characteristics will be discussed as they pertain to recycling. Transportation, handling, and receiving facility records will be attached to the final report. The value of liquid product produced from FBA will be evaluated relative to the criteria used by the recycler to identify the grade of liquid for recycling; elevated water content, high dissolved solids, and/or high suspended solids will indicate the liquids are characterized as a water-grade for recycling. Acceptance as a fuel-grade liquid for recycling will require that the liquid exhibit a minimum BTU content.

Reduced Energy Use - Current draw measured during the test will be extrapolated to estimate annual power consumption for the test unit. The final report will include discussions regarding power usage at high and low influent VOC concentrations. Power use will be discussed relative to the equipment in use.

#### 4.4.2 Evaluate Cost Effectiveness

Costs from the test will be compiled and discussed relative to comparable technologies, specifically granular activated carbon (GAC) and catalytic oxidation. The cost efficiency of full life-cycle operation of FBA will be evaluated by extrapolating the costs measured during the test at both high and low influent VOC concentrations. The evaluation will include power, labor, and material costs, including handling, transporting, and recycling liquid solvent generated from the process. HLA will estimate operation costs of comparable treatment equipment operating under similar conditions. The cost comparison will identify both capital and operating expenses for comprehensive evaluation of the total implementation costs.

It is HLA's understanding McClellan AFB will provide a standardized set of hypothetical site conditions to normalize the comparison of FBA with standard technologies. The FBA test data will be used to extrapolate full-scale operations under similar conditions using FBA equipment designed for these standard conditions.

#### 4.4.3 Extent of Mass Removal

BACT Treatment Criteria - The DREs measured during the FBA Test will be compared against the desired BACT treatment criteria of 95 percent or greater removal efficiency. DRE is the percent-reduction observed in the concentration of a specific analyte, such as NMOCs, between the FBA test unit influent and effluent. DRE is calculated as follows:

$$\% \text{ DRE} = \frac{\text{mass NMOCs entering FBAS} - \text{mass NMOCs leaving FBAS}}{\text{mass NMOCs entering FBAS}} \times 100$$

DREs for TCE and 1,1-DCE will be calculated in a similar manner as the NMOCs.

Mass balance calculations will be presented showing the mass of constituents entering the FBA system in vapor phase and then leaving the system as a vapor-phase emission, liquid-phase product, or retained on resin as follows:

- The mass of VOCs entering and leaving the FBA test unit in as a vapor will be calculated based on flow rate and chemical analyses results on influent and effluent vapor samples.
- The volume of liquid will be volumetrically calculated based on container capacity. The contributing portions of each separate phases will be estimated, if observed, based on the depth to the product/water interface. The mass distribution of analyte constituents in the liquid product will be estimated based on chemical analyses results.

Ninety Percent Operation Time - Operating status records will be compiled and used to estimate the total amount of downtime experienced by the FBA test unit. Shutdowns caused by occurrences that are unrelated to FBA operations, such as a shutdown of the site's existing catalytic oxidation system, will be subtracted from both the downtime and total test duration time. Percent operation time will be calculated by dividing the adjusted operating time by the adjusted test duration. The report will discuss the system shutdowns and their implications regarding overall FBA performance.

Satisfactory SOC Adsorption/Desorption - The mass of VOCs and SOCs retained on the resin will be evaluated based on the resin sample analyses results. HLA will also compare FBA performance, as measured by the DREs, against the accumulation of SOCs on resin over time.



## 5.0 FIELD ACTIVITIES

### 5.1 Site Characterization

McClellan AFB has fully characterized test site IC-31 and implemented remediation in accordance with the basewide RI/FS. The FBA test has been designed for the conditions at the test site. No further site characterization is needed for the FBA test.

### 5.2 System Installation

HLA has prepared drawings that show the installation and configuration of the FBA test unit on the existing equipment pad at Site IC 31. In addition to the Process Flow Diagram (Plate 2) and Instrumentation Diagram (Plate 3), a FBA Test Layout Diagram (Plate 4) and One-Line Diagram (Plate 5) have been prepared showing the configuration of the FBA test unit, existing utility connection points (including power, telephone, tap water, sewer drain), and electrical requirements. These drawings will be used by McClellan AFB personnel to obtain the required base clearances and permits.

After receiving base clearances, HLA will procure equipment and supplies to install the temporary facilities needed for the test. As indicated on the Process Flow Diagram (Plate 2), PVC piping will be attached to existing flanges on the SVE system and extended to the FBA test unit. A positive displacement blower equipped with a 15-horse power electric motor will be installed to pull a slip stream of 100-cfm from well VW-5001 through the FBA test unit and then back into the SVE system upstream of the catalytic oxidizer. The FBA test unit will be loaded with new Amborsorb<sup>®</sup> 600 carbonaceous adsorbent. A nitrogen tank will be secured to the FBA test unit to provide a non-combustible purge gas in the desorber.

Supply water, used for non-contact cooling at a rate of less than 6 gpm, will be connected to the FBA test unit with flexible hose secured to the concrete pad. All vessels containing non-cooling water liquids will be installed within secondary containment with a minimum capacity of 110 percent of the primary containment vessels.

A licensed electrician will connect the FBA test unit to the IC 31 power supply and will work with URS to connect instrumentation for system shut downs. The FBA test unit will shut down concurrently with any shut down of the existing catalytic oxidizer. High level conditions in the water knock-out tank or solvent recovery vessels will also shut down the FBA test unit. An autodialer will notify HLA maintenance personnel of a system shut-down via telephone.

### 5.3 System Operation

Operation of the FBA test unit will be conducted in two phases: startup and test. The FBA test unit will be checked out and adjusted during the startup phase to make sure the system is fully operational before beginning the actual test phase documenting FBA performance.

Before processing any SVE vapors, resin bead samples will be collected from the FBA test unit desorber and analyzed for baseline concentrations of VOCs, total petroleum hydrocarbons using purging recovery methods (TPHp, EPA Test Method 5030), and TPH using extraction recovery methods (TPHe, EPA Test Method 3550). TPHp and TPHe will be used to recover volatile and semi-volatile fuel constituents,

respectively. VOCs will be analyzed using EPA Test Method 8240 (EPA 8420) and TPH will be quantified with modified EPA Test Method 8015 (modified EPA 8015).

### **5.3.1 Startup Phase**

The purpose of the startup phase is to adjust the FBA test unit operating parameters so that the test unit meets or exceeds the minimum BACT criteria of 95 percent DRE under initial VOC concentration conditions. Startup testing and system adjustments are anticipated to take five days, depending on the complications encountered connecting the FBA and cat-ox treatment systems. The system performance is adjusted by varying the following process and operating parameters:

- Process gas flow rate through the adsorber
- Process gas inlet temperature
- Influent VOC concentrations, adjusted with dilution air
- Adsorbent transfer rate between adsorber and desorber
- Desorber set point temperature
- Condenser set point temperature
- Nitrogen purge gas flow rate.

Process gas flow rate will be controlled by varying the speed of the auxiliary PD blower or by adjusting the control valve on the process gas stream inlet. Process gas temperature will be controlled by adjusting the inlet heat exchanger. Influent VOC concentration in process gas will be varied by adjusting the dilution air valve. Built-in ball valves in the adsorbent transport lines will be used to control adsorbent transfer rate. Desorber and condenser set point temperatures are set by built-in controls in the steam boiler and liquid chiller, respectively. Finally, nitrogen gas will be monitored and controlled by a rotameter equipped with a control valve.

On the first day of startup, an initial influent vapor sample will be collected for analysis of NMOC by Test Method E18 (E18) and VOCs by modified EPA Test Method 8021 (EPA 8021) to establish current conditions. For the remainder of the startup phase, VOC concentrations will be monitored with a photoionization detector (PID) to provide immediate readings. The FBA test unit will be operated up to four more days and additional adjustments to the system will be made, if necessary, based on PID readings and field observations. The goal of the adjustments is to achieve operating conditions that yield consistently high DREs. On the fifth and last day of the startup phase, three sets of influent and effluent vapor samples will be collected and analyzed using field PID readings, onsite laboratory analyses using EPA 8021 and E18, and off site laboratory analyses using TO-14.

### **5.3.2 Test Phase**

Formal testing will comprise two test periods, a six-week period at high NMOC and VOC concentrations (approximately 1,000 ppmv) and a three-week period at low influent concentrations (approximately 300 ppmv). The high concentration value is an estimate based on the capacity of the FBA test unit, which is dictated by the test unit size and available residence time. Full scale units can be designed with longer residence times to treat higher concentrations.

The transition between high and low concentration test phases will be performed during a one- to two-day abbreviated startup period. During this period system parameters will be adjusted and monitored to achieve satisfactory performance at a lower influent concentration.

1 An HLA technician will conduct weekly field monitoring visits for routine operation, maintenance, and  
2 monitoring of the FBA test unit during the test phase. The field technician will check the flow rate and  
3 pressures to maintain consistent operating conditions throughout the duration of the test. In addition to  
4 PID readings, influent and effluent samples will be collected and analyzed for VOC concentration data as  
5 presented in Section 7.

6 In addition, HLA will record hours of operation, electrical and nitrogen usage, and amount of solvent  
7 recovered during the test. Hours of operation will be recorded by a built-in hour meter in the extraction  
8 system control box. Nitrogen usage will be controlled and monitored by an in-line rotameter equipped  
9 with an adjustable valve. FBA test unit amperage readings will be collected using an analog, rotary-scale  
10 ammeter during each site visit. Electrical usage will then be calculated by multiplying the amperage by  
11 the known voltage use and the hours of operation. Qualitative assessment of the amount of liquid  
12 recovered will be conducted by a visual inspection of the liquid in the condensated drum. Quantitative  
13 distribution of solvent and water will be estimated using interface probe measurements and laboratory  
14 analyses of the recovered liquid.

15 In the event of a system shutdown, an HLA field technician will visit the site and record the cause. If the  
16 shutdown is FBA system-related, the field technician will perform the necessary repairs and adjustment to  
17 resume system operation. If necessary, the field technician will also perform adjustments to maintain the  
18 system DREs at levels that are as high as possible.

19 During the test phase, PID readings will be obtained for influent and effluent on each weekly site visit.  
20 NMOC and VOC inlet and effluent concentrations will be measured bi-weekly using a E18 and EPA 8021,  
21 respectively. Additional influent and effluent vapor samples will be collected for VOC analysis by an off  
22 site laboratory using TO-14 in accordance with the sampling plan presented on Table 4 and discussed in  
23 Section 7. DRE for VOCs and NMOCs will be calculated as presented in Section 4.4.3.

#### 24 **5.4 Residual Management**

25 This section provides a waste management plan for the FBA Test, in accordance with the PWS (McClellan  
26 AFB, 1996b). HLA does not anticipate generating any hazardous waste exclusively as the result of HLA's  
27 own activity; however, removal of chemicals from soil may generate hazardous wastes which will be  
28 handled as described below. Also, Material Safety Data Sheets for the Amborsorb<sup>®</sup> 600 adsorbent and  
29 other products required for its installation and operation of the FBA test unit are included in Appendix D.

##### 30 **5.4.1 Liquid-Phase Product**

31 VOCs will be removed from extracted soil vapors and collected as liquid-phase product for recycling.  
32 HLA will monitor the drums for the presence of water and product as separate phases using an interface  
33 probe. Water content will be monitored closely because high water content decreases the quality rating of  
34 the liquid for recycling purposes and greatly affects the total amount of liquid that will be produced by  
35 the FBA test unit. Based on operational data collected for FBA units at other sites and vapor data for  
36 IC 31, HLA estimates a liquid removal rate of four to eight gallons per day with a 50 percent liquid phase  
37 product and 50 percent water distribution. This would yield approximately 250 to 500 gallons of liquid  
38 condensate over a 70-day test period with 90 percent operational time.

#### **5.4.1.1 Liquid-phase Product Handling**

Condensate will be collected in DOT-approved, 55-gallon, close-head polyethylene drums housed in a secondary container. The product will consist of liquid-phase hydrocarbons that may have ignitable characteristics (RCRA classification D001) and toxicity characteristics from elevated TCE concentrations (RCRA classification D039). The condensed product will be handled as a RCRA hazardous waste from the time of collection until accepted at the recycling facility.

The secondary container will be capable of holding a minimum of 110 percent the capacity of the drum. A level switch, rated for service in explosive environments, will prevent drums from exceeding 90 percent of the drum capacity. Condensate drums will display a label at all times while in use indicating the contents. After filling, the sealed DOT-approved drums condensate will remain on site for less than 90 days.

Romic Chemical Corporation (Romic) will transport the drummed product to its solvent recycling facility in East Palo Alto, California, which is licensed to accept materials that are classified as RCRA and non-RCRA hazardous wastes. The material will be transported by Romic, a licensed waste hauler, under a hazardous waste manifest signed by the appropriate McClellan AFB representative.

#### **5.4.1.2 Product Characterization and Recycling**

Romic will test a sample of the product at their facility's laboratory for fuel value to determine the appropriate recycling process stream at their facility. Romic will also analyze the product sample for total dissolved solids, total suspended solids, and chloride content to classify the product's fuel grade characteristics. Romic will process the product for resale as purified solvent or blended into an alternative heating fuel. McClellan AFB will receive a certificate from Romic documenting that the product was recycled for reuse.

Romic is a chemical recycler that has operated in East Palo Alto for 30 years. Romic recycles used chemicals such as solvents, antifreeze and oils in two ways: purifying them so they can be sold back to industry for reuse or blending them into an alternative heating fuel. The alternative fuel from Romic is used by cement kilns in place of conventional fuels such as natural gas, oil, and coal. Recycling recovered liquid product from the FBA Test provides the advantages of finding a beneficial use for used chemicals that would otherwise have to be disposed of and offsetting the use of conventional fuels (thereby conserving natural resources).

#### **5.4.2 Spent Resin**

Resin beads are capable of reuse for constituents that volatilize within the design temperatures of the FBA test unit. Resin may become saturated with constituents that do not volatilize readily; in this event, the resin may need to be regenerated at an offsite facility that can achieve the needed desorption temperatures. Approximately 80 to 90 pounds (approximately 2.4 to 2.7 cubic feet) of spent resin may require offsite regeneration or disposal. The classification of spent resin will be evaluated based on the test analysis of the final set of resin samples.

#### **5.4.3 Air-Water Separator Liquid**

Liquid captured by the air-water separator (AWS) from the SVE vapors will be retained in a double contained collection tank on the blower skid at the site. These liquids will be combined with other AWS liquids generated at IC-31 for handling and processing.

**5.5 Demobilization and Site Restoration**

Upon completion of the pilot test, HLA will remove the FBA test unit, piping, and utility connections used for the test. Nitrogen tank demobilization and removal will be conducted by the nitrogen vendor.

Since no intrusive work is required to install the FBA test unit, no adverse impacts are expected in the surrounding environment. Other than the removal of debris associated with the test, no other site restoration activities are anticipated.

## 6.0 PERMITTING AND REGULATORY COMPLIANCE

### 6.1 Permitting

McClellan AFB has provided accommodations at Site IC 31 that allow for operation of the FBA test unit with operations permitted by McClellan AFB. This WIP and the subsequent design drawings (Section 5.2) will provide the basis for McClellan AFB personnel to obtain necessary utility clearances and permits for the FBA test installation and operation.

Section 4 of the Performance Work Statement (PWS) provided by McClellan AFB with the contract award documentation establishes safety and waste management specifications that act as permit requirements for the FBA test operations.

No permits from outside agencies, such as Sacramento Metropolitan Air Quality Management District, are required for this test. Air emissions permitting is not required because the test will be conducted on a slip stream without a separate discharge. The existing CatOx system operates in compliance with SMAQMD requirements and will treat FBA system emissions.

### 6.2 Regulatory Compliance

The FBA test will conform with regulatory requirements including:

- Health & Safety requirements, including applicable OSHA and California OSHA regulations as specified in the HASP (Appendix B)
- RCRA as authorized by the State of California hazardous waste management regulations: California Department of Toxic Substances Control. In particular, requirements for generators and transporters of hazardous waste: 22 CCR 66261 through 66263
- Hazardous Material Transportation Regulations: US Department of Transportation. In particular, 49 CFR Parts 171 and 172
- California Air Act: Sacramento Metropolitan Air Quality Management District. The FBA test will comply with air quality regulations through the Permit to Operate issued to McClellan AFB, including fugitive emissions requirements, if any.

## 7.0 SAMPLING PLAN

The sampling schedule summarizing sampling parameters, frequencies, and test methods for the FBA Test is discussed in this section and presented on Table 4. Sampling container types and holding times are presented on Table 5. The rationale for vapor and emission sampling is summarized on Table 6. Standard Operating Procedures (SOPs) for all of the chemical analyses methods referenced in this section are provided in Appendix C.

### 7.1 Pre-operational Sampling

Pre-operational sampling will be conducted during the 5-day startup phase (Week 1 startup shown on Table 4) to document baseline conditions and check the functionality of the FBA test unit before proceeding with the test.

#### 7.1.1 Resin Baseline

Performance analyses of the recently modified desorber will be evaluated based on accumulation of SOCs on the Amborsorb® 600 resin assessed at intervals during the test. The initial baseline assessment will be performed prior to testing.

##### 7.1.1.1 Sampling Objectives

The objective of resin baseline sampling is to establish the baseline condition of the virgin adsorbent in the FBA test unit delivered to IC 31.

##### 7.1.1.2 Sampling Rationale

The testing protocol for the resin beads is intended to quantify the same VOCs and hydrocarbons identified in vapor- and liquid-phases throughout the FBA test unit. Semivolatile hydrocarbons may strongly adhere to the resin; as a result, volatile purging techniques used for recovery of hydrocarbons from vapor- and liquid-phase samples may not adequately remove the strongly-adsorbed semivolatile hydrocarbons from the resin. An extractable recovery technique has been selected to facilitate the recovery of these semivolatile hydrocarbons, if present.

##### 7.1.1.3 Field Methods and Procedures

Resin bead samples will be collected from the FBA test unit desorber in an 8-ounce glass jar and analyzed for baseline concentrations of VOCs using EPA 8240, TPHp using EPA 5030/modified EPA 8015, and TPHe using EPA 3550/modified EPA 8015 on Day 1 of the Startup phase.

##### 7.1.1.4 Quality Control Sampling

No quality control sampling will be conducted for the pre-operational resin sampling. Virgin resin beads will be provided; therefore, chemical analysis will likely indicate no chemicals present above detectable concentrations and additional QC analyses are not necessary. Chemical results will be validated in accordance with the QAPP (Section 8.0).

## **7.1.2 System Startup and Optimization**

After the FBA test unit is installed, monitoring will be conducted to obtain and maintain effective system performance.

### **7.1.2.1 Sampling Objectives**

One objective of startup sampling is to obtain instantaneous screening-level data to observe how various parameters affect system performance and then adjust the settings as needed, as discussed in Section 5.3.1. A second objective is to document process stream influent and effluent concentrations at the start of the test.

### **7.1.2.2 Sampling Rationale**

PID measurements are used to quantify VOC concentrations during the startup phase because they provides instantaneous results that can be used to monitor the effects of adjusting multiple process parameters. Laboratory analyses will provide more definitive initial VOC concentration data.

### **7.1.2.3 Field Methods and Procedures**

Field procedures during startup will comprise three activities: system parameter monitoring, sample collection, and sample analysis. System parameter monitoring includes observation of pressure, flow, and temperature readings and noting them on the field log (Table 2). This will take place several times daily during the first five days of startup operation. Flow rate data will be obtained using a Preso venturi flow meter (venturi) installed downstream of the adsorption tower. A magnehelic gauge connected to the venturi metering taps will be used to measure the pressure differential across the venturi in inches of water column (in. H<sub>2</sub>O). The pressure differential across the venturi, the soil vapor temperature, and the line pressure upstream of the venturi will be used to calculate the system flow rate in standard cubic feet per minute (scfm). Pressure and temperature values of 14.7 psia and 60°F, respectively, will be used to convert to standard flow conditions.

Sample collection for vapor concentration analysis includes 1-filter Tedlar<sup>®</sup> bags and SUMMA<sup>®</sup> canisters. For Tedlar<sup>®</sup> bag sampling, samples will be collected by connecting the bags to the sampling port using Teflon<sup>®</sup> or other inert tubing. If the vapor in the process stream is under vacuum or low pressure, a vacuum box will be used to fill the bag. Each sample location will have dedicated tubing and bags (for repeated field measurements) to prevent cross contamination. Tedlar<sup>®</sup> bag samples collected for laboratory analysis will be stored out of sunlight to prevent photochemical reactions and transported under chain of custody to an onsite laboratory.

Vapor samples using SUMMA<sup>®</sup> canisters will be collected using the laboratory-supplied stainless steel flow controller and fittings. A 1/4-inch inert tubing equipped with a barbed, quick-disconnect, male fitting will be attached to the sampling canister using a ferrule nut. The SUMMA<sup>®</sup> canister will then be attached via the inert tubing to a female, quick-disconnect fitting installed at the sampling location. Once the SUMMA<sup>®</sup> canister has been connected, the valve in the flow controller is fully opened and process air allowed to enter the canister. After one minute, the flow controller valve is closed and the hose disconnected. A new quick-disconnect fitting and sampling tube will be used for each sampling location. SUMMA<sup>®</sup> canisters will be transported under chain of custody to a state-certified laboratory for analysis.

Vapor VOC concentration will be measured in the field using a Photovac's Microtip<sup>®</sup> HL 2000 PID equipped with a 10.6 electron-volt (eV), ultraviolet lamp, or a Thermo Environmental Instruments, Inc.'s organic vapor monitor (OVM) Model 580B equipped with a 10.0 eV lamp. Prior to each system monitoring event (i.e., daily), the PID will be calibrated per manufacture's instructions using a 100 ppmv



isobutylene gas standard. PID measurements will be conducted immediately after extraction. PID measurements will be taken one to several times daily during the 5-day startup phase.

One Tedlar® bag sample will be collected on Day 1 of the startup phase and analyzed using Test Methods E18 and 8021. On Day 5 after FBA test unit operations have been properly adjusted, a second set of Tedlar® bag samples will be collected for GC analyses using modified Test Methods E18 and 8021, and SUMMA canister samples will be collected for GC/MS analyses using TO-14. Sampling and analyses protocol will be conducted in accordance with the SOPs presented in Appendix C for NMOC by modified Test Method E18, and VOCs by modified Test Method 8021 and TO-14. Chemical analyses results will be validated in accordance with the QAPP (Section 8). DREs for NMOC and VOCs will be calculated as presented in Section 4.4.3.

#### **7.1.2.4 Quality Control Sampling**

For the sampling event on Day 5 (Table 4) at which three samples are collected for separate analyses by PID, E18/EPA-8021, and TO-14, a field duplicate will be collected and analyzed by E18/EPA 8021 to provide a QC check of the samples submitted for analyses to the on site laboratory. Field duplicates will be collected by simultaneously filling two Tedlar® bags in the same vacuum box. A stainless steel "T" in the tubing will be used to split the flow to the bags. One field blank will also be collected on Day 5 during the startup phase. This will be collected in a SUMMA® canister at a location 20 feet away from the operation equipment and 5 feet above ground surface during relatively calm wind conditions. The field blank will be analyzed by TO-14. Chemical analyses results and PID readings will be compared to identify correlations between the screening PID measurements and the definitive laboratory results.

### **7.2 Operational Sampling**

#### **7.2.1 NOx**

##### **7.2.1.1 Sampling Objectives**

Sampling will be conducted to demonstrate that FBA, which recovers VOCs rather than oxidizing them, does not generate significant NOx emissions; SOx emissions will not be measured because no sulfur compounds have been observed at the site. If detected, any NOx quantities will be compared with McClellan AFB cumulative limits and the amounts of NOx that would be anticipated from comparable technologies.

##### **7.2.1.2 Sampling Rationale**

A source test will be conducted on site in a mobile laboratory. A mobile onsite laboratory is the only alternative for measuring NOx, since it degrades too rapidly to allow for transportation to an offsite laboratory in a sampling container.

##### **7.2.1.3 Field Methods and Procedures**

The one-day source test for the presence of NOx will be conducted onsite in accordance with the SOP for California Air Resource Board (CARB) Method 100 in Appendix C. The source test will be conducted during Week 4 of operation.

##### **7.2.1.4 Quality Control Sampling**

Quality control will be achieved by implementing the CARB-100 test protocol by a state-certified laboratory.

## **7.2.2 Non-corrosive Discharge**

### **7.2.2.1 Monitoring Objectives**

Corrosion monitoring of the FBA test unit effluent vapor stream will be conducted to demonstrate non-corrosive discharges.

### **7.2.2.2 Monitoring Rationale**

Corrosion impacts will be monitored inside the FBA test unit discharge stack by means of a CORROSOMETER® probe (probe) and in the desorber by measuring the pH of the condensate. These two locations were selected because of their proximity downstream from the heat source in the desorber where acid would most likely be formed. The probe mass will be recorded at a minimum of four times per day to provide a time log of mass loss from corrosion; the results will be used to calculate the corrosion rate of the stack internal coating. Periods exhibiting accelerated corrosion will be cross-referenced with operation logs to identify activities that may have increased corrosion during the FBA process.

### **7.2.2.3 Field Methods and Procedures**

Corrosive impacts resulting from the system offgases will be measured in accordance with CORROSOMETER® operating procedures on a continuous basis throughout the test. The electrical resistance corrosion probe will be placed inside the discharge stack. The probe will be constructed of materials used in the stack interior coating for a commercial-size unit. A CORRDATA® remote data collector (RDC) will be used to monitor real-time mass reduction of the probe at predetermined time intervals. During weekly site visits, the field technician will collect the accumulated mass reduction data recorded by the RDC using a MATE® portable data logger (logger); the data can then be transported to the office. Data transported in the logger will be transferred to a personal computer equipped with CORRDATA® software which will provide graphical displays of corrosion time history over the entire project life.

Corrosion impacts will be monitored in the desorber by testing the pH of the condensed liquid product and/or water (condensate). Condensate samples will be collected from a sample port in the condensate discharge line using a wide mouth glass jar with a virgin Teflon® capliner. Condensate samples will be stored in an iced cooler and transported to the laboratory accompanied by chain of custody forms initiated by the field technician. The condensate sample will be transported to a State of California certified laboratory for pH analysis by EPA Method 9040. One condensate sample will be collected for pH analysis during the high inlet concentration period (Week 4).

### **7.2.2.4 Quality Control Methods**

Installation of the probe, and collection, transport, and transfer of the corrosion data will be performed per manufacturer instructions. All mechanical and electrical connections for the probe and RDC will be visually inspected during weekly site visits by the field technician. Repairs or adjustments to the corrosion monitoring equipment will be conducted as needed. Probe weight will be measured before and after testing to identify and document instrument drift.

## **7.2.3 Recycled Product**

### **7.2.3.1 Sampling and Documentation Objectives**

Sampling and analysis of the product condensate will be conducted to demonstrate that it is a product suitable for recycling rather than disposal. Waste characteristics will be evaluated for handling purposes until the condensate has been accepted at Romic's facility for recycling. Romic will provide documentation that the condensate was delivered to and became the property of the recycling facility upon receipt of the product. Romic will recover the various constituents as a recycled solvent or blend the product into heating fuel for use in a cement kiln furnace.

### **7.2.3.2 Sampling Rationale**

Condensate samples will be collected and analyzed to evaluate the product's fuel grade characteristics. Condensate sampling will be conducted during the high inlet VOC concentration period. Laboratory analyses will provide a chemical profile of the condensate collected during the high concentration phase. Analyses of the laboratory data will be used to identify future system operational parameters that maximize recycling characteristics of the condensate.

### **7.2.3.3 Field Methods and Procedures**

Liquid phase product samples will be collected for laboratory analysis using disposable polyethylene coliwasa. Samples will be collected from the condensate drum from each identifiable phase. The sampler will seek to identify phase separation in the condensate drum using a Solnist Model 121 or MMC Model 100BS oil-water interface probe. Once collected, condensate samples will be transferred to laboratory-supplied vials for transport to a state-certified laboratory for analysis. Vials containing the condensate samples will be stored in an iced cooler and transported the laboratory under a chain of custody record. Condensate sampling will be performed by a state-certified laboratory in accordance with the SOP for EPA Test Method 8240 (Appendix C) to quantify the type and distribution of VOCs and any water content. Romic will conduct additional analyses at their facility laboratory including total dissolved solids, total suspended solids, pH, and chloride content to classify the product's fuel grade characteristics.

### **7.2.3.4 Quality Control Methods**

Chemical analyses results will be validated in accordance with the QAPP (Section 8).

## **7.2.4 Utility, Labor, and Material Cost**

### **7.2.4.1 Documentation Objectives**

Utility, labor, and material usage will be recorded to analyze cost savings relative to comparable technologies for the full life-cycle of a soil vapor extraction project.

### **7.2.4.2 Documentation Rationale**

Costs for the full life-cycle operation of the system will be developed based on FBA test results by extrapolating the costs measured while treating high and low concentrations and applying them over time to simulate typical conditions as a site cleanup matures. HLA will estimate operation costs of comparable treatment equipment operating under similar conditions. The cost comparison will identify both capital and operating expenses for comprehensive evaluation of the total implementation costs. In addition, system operation parameter settings that reduce operation costs while maintaining required minimum DREs will be documented and extrapolated for a commercial-size unit.

#### **7.2.4.3 Field Method and Procedures**

During weekly site visits, the field technician will collect FBA test operational parameters including utility usage. Individual nitrogen and water usage will be measured by dedicated flow meters and total run time of the system will be measured by an hour meter. Total nitrogen and water usage will be calculated by multiplying the average usage of each utility by total uptime of the unit. Power consumption will be estimated by measuring the current drawn by the FBA test unit and extraction blower during each site visit. Current draw will be measured using an AMPROBE® and recorded in a log sheet. Total electrical consumption will be calculated by multiplying the current draw times the nominal voltage and operational time. Total electrical and water utility cost will be calculated based on current utility rates applicable for McClellan AFB.

Labor cost will be recorded based on the number of hours spent by HLA personnel for field work. HLA field labor will be classified as operation and monitoring, preventive maintenance, and repairs for tracking purposes. Communication costs will be reported as a lump sum.

Monitoring costs involving subcontractor work will be reported based on number of vapor analyses performed. Condensate disposal costs will be based on the amount of condensate recovered by the FBA test unit and sent to Romic for recycling.

Miscellaneous equipment charges and necessary supplies for routine system operation and maintenance will be reported as a lump sum item.

#### **7.2.4.4 Quality Control Methods**

Utility measurement will be conducted on a weekly basis by the field technician. In addition, visual inspection of hour, nitrogen, and water meters will be conducted during each site visit. Prior to each site visit the field technician will verify proper working operation of all monitoring equipment.

HLA labor, subcontractor, equipment, and material costs will be tracked by HLA using standard accounting methods.

#### **7.2.5 Mass Removal Sampling**

##### **7.2.5.1 Sampling Objectives**

Influent and effluent data will be collected to assess the removal effectiveness of the system and estimate the mass flow rate.

##### **7.2.5.2 Sampling Rationale**

The extent of VOC mass extracted from the vadose zone and removed by the system will be monitored throughout the FBA test. Flow rate data and concentration data of VOCs entering and leaving the FBA test unit will be compiled and used to calculate the mass removal rate. In addition, influent and effluent VOC concentration data will be used to calculate destruction and removal efficiencies (DREs) for the system. Field measurements and laboratory analyses of influent and effluent samples collected during the test will be used to assess the effectiveness of the system to treat compounds present in the vadose zone. In addition, chemical sampling will be used to assess how varying various process parameters affect DRE.

**7.2.5.3 Field Methods and Procedures**

Sampling and data collection procedures will be the same as those used during startup (Section 7.1.2.3). These include system operating parameter monitoring (flow, pressures, temperatures) which will be observed and recorded at each weekly field visit. Tedlar® bag and SUMMA® canister sample collection and analysis will also follow the same procedures. Sampling frequency of influent and effluent vapors and proposed laboratory analyses for VOCs and NMOs are summarized on Table 4.

**7.2.5.4 Quality Control Sampling**

Quality control sampling and procedures during the test phase will be the same as those specified during startup (Section 7.1.2.4) except as identified below. All routine field procedures, such as PID calibration, will be the same. QC samples for laboratory analysis will be collected during Weeks 4 and 8 (Table 4). During Week 4, both a field blank and a field duplicate will be collected in Tedlar® bags for EPA 8021 and E18 modified analyses; no SUMMA canisters are scheduled to be used for sample collection during this time. Field blanks and field duplicates will be collected using laboratory-supplied SUMMA® canister and/or Tedlar® bags using field procedures outlined in Section 7.1.2.4. Week 8 is the first week of operation at lower concentrations and both the system and QC sampling schedule is the same as specified for Day 5.

**7.2.6 Downtime**

**7.2.6.1 Documentation Objectives**

The operating status of the FBA test unit will be documented to demonstrate that the unit can achieve 90 percent operation time during the pilot test.

**7.2.6.2 Documentation Rationale**

During each site visit, the field technician will record the amount of operating time since the previous field visit. Cumulative downtime will be documented and an explanation for the downtime recorded. Downtime documentation will be used to categorized downtime as: (1) isolated occurrences, (2) unrelated to system performance, or (3) disruptions that are inherent to the technology.

**7.2.6.3 Field Methods and Procedures**

A motor-driven AC hour meter will be used to record hours of operation of the blower and FBA test unit. During each weekly site visit the field technician will record the hour meter reading and calculate the total hours of operation since the previous visit. The hour meter will also be used to estimate date and time of each shutdown event.

Electrical controls will be used to shutdown the FBA test unit in the event the existing cat-ox unit shuts down. System downtime caused by the cat-ox shutdowns will be recorded as unrelated to the FBA test unit performance. Necessary repairs to restart the cat-ox will be conducted by others. Once cat-ox operation has resumed, HLA will resume FBA test operations.

FBA system related shutdowns will be documented and an explanation recorded by the field technician. The field technician will perform the necessary adjustment or repairs to resume system operation.

1 Operation time percentage for the FBA test unit will be calculated as follows:

2 
$$\% \text{ FBAS Uptime} = \frac{\text{Total FBAS Uptime} - \text{Total FBAS Related Downtime}}{\text{Total Test Time} - \text{Total FBAS Unrelated Downtime}} \times 100$$

3 In addition, shutdown notification will be accomplished using an autodialer on the FBA test unit control  
4 panel. In the event that a shutdown notification is received via the telephone autodialer, a field  
5 technician will travel to the site to diagnose the cause of the shutdown and manually restart the FBA test  
6 unit.

7 **7.2.6.4 Quality Control Methods**

8 Hour meter and autodialer operation and connections will be checked by the field technician during each  
9 site visit.

10 **7.2.7 Resin Followup**

11 HLA will submit Ambersorb<sup>®</sup> 600 resin samples as follow-up to the baseline sample (Section 7.1.1).

12 **7.2.7.1 Sampling Objectives**

13 Followup sampling will be performed to assess adsorption performance changes, if any, over time.

14 **7.2.7.2 Sampling Rationale**

15 The testing protocol for the resin beads is intended to quantify the same VOCs and hydrocarbons  
16 identified in vapor- and liquid-phases throughout the FBA test unit. Semivolatile hydrocarbons may  
17 strongly adhere to the resin; as a result, volatile purging techniques used for recovery of hydrocarbons  
18 from vapor- and liquid-phase samples may not adequately remove the strongly-adsorbed semivolatile  
19 hydrocarbons from the resin. An extractable recovery technique has been selected to facilitate the  
20 recovery of these semivolatile hydrocarbons, if present.

21 **7.2.7.3 Field Methods and Procedures**

22 Resin bead samples will be collected from the FBA test unit adsorber and desorber in an 8-ounce glass jars  
23 and analyzed for concentrations of VOCs using EPA 8240, TPHp using EPA 5030/modified EPA 8015, and  
24 TPHe using EPA 3550/modified EPA 8015 during Weeks 2 (high influent concentrations period),  
25 8 (transition period), and 10 (low concentration period and end of test).

26 **7.2.7.4 Quality Control Sampling**

27 Chemical results will be validated in accordance with the QAPP (Section 8).

## 8.0 QUALITY ASSURANCE PROJECT PLAN

### 8.1 Introduction and Objectives

This Quality Assurance Project Plan (QAPP) has been prepared to address work activities in support of the PRDA FBA test at McClellan AFB, Site IC 31 under contract number F04699-97-C-0102. This QAPP serves as the primary guide for the integration of QA/QC functions into the PRDA FBA test; in addition, the Basewide RI/FS QAPP provides the basis for QA/QC protocol during the FBA test. This QAPP presents the procedures, organization, objectives, functional activities, and specific QA/QC activities designed to achieve data quality goals established for each phase of FBA test.

### 8.2 Measurements

Measurements described in this WIP are used to determine the efficacy of the FBA test unit operating at Site IC 31. Collection of both screening level and definitive analytical data is proposed to meet the objectives of each phase of the FBA test. Field instrument measurements for VOC concentrations will be considered screening level data. Field instrument measurements will be considered definitive for flowrate, temperature, and pressure. Chemical analyses conducted by a state-certified laboratory will be considered definitive data due to the QC requirements and detection limits of the analytical methods used by these laboratories. Off-site laboratory data will be used to check 10 percent or more of the on-site laboratory results, with the exception of CARB-100 testing which requires onsite testing. The data quality levels associated with each analytical method and the rationale for use of that method are presented in Table 6.

### 8.3 Quality Assurance Organization and Key Personnel

The PRDA FBA test project organization is presented on Plate 6. This figure shows key positions along with lines of authority and lines of communication and coordination for project QA procedures. All individuals will understand the roles their functional areas play in the PRDA FBA test.

QA personnel have sufficient authority, access to work areas, and organizational freedom to identify quality problems; to initiate, recommend or provide solutions to problems through established channels; and to verify solution implementation. Such personnel are responsible to see that all work, including any processing of information, delivery of products and installation or use of equipment, is reviewed in accordance with QC objectives and that all deficiencies and non-conformances are corrected. QA personnel have direct access to senior management and the required authority to carry out QA duties.

#### 8.3.1 Project Manager

The HLA Project Manager (HLA PM) has overall QA responsibility and authority for project coordination between the McClellan AFB and HLA. The HLA PM, Mr. David Hochmuth, is responsible for the development and approval of all project documents, including this WIP, the health and safety plan (H&SP), standard operating procedures (SOPs), contract documents, and reports. Specific duties of the HLA PM are as follows:

- Provides senior level input and expertise on developing or establishing project objectives, data quality objectives (DQOs), sampling rationale, regulatory requirements, and data assessment methods
- Provides guidance and direction to the project staff, as necessary

- 1 • Monitors the progress of work in relation to scope and schedule
- 2 • Provides senior level coordination and review on project documents
- 3 • Confers with the HLA team members on activity-specific issues
- 4 • Identifies quality problems and concerns for investigation and resolution.

### 5 **8.3.2 Project Quality Control Officer**

6 The Project Quality Control Officer (PQCO), Mr. Christopher Smith, operates independently of the HLA  
7 PM and is responsible for overall implementation of QC protocol throughout the project duration. The  
8 PQCO's specific responsibilities are as follows:

- 9 • Ensures that the Project Quality Control System Manager and Project Quality Control Field Manager  
10 are operating in compliance of the QA/QC protocol and QAPP requirements.
- 11 • Inspects work activities and project deliverables to check that QA/QC activities are not compromised  
12 by other concerns, such as unexpected scheduling impacts or budgetary constraints.
- 13 • Meets with HLA PM to discuss any perceived quality deficiencies and establish corrective measures to  
14 rectify deficiencies to comply with QAPP requirements.

### 15 **8.3.3 Project Quality Control System Manager**

16 The Project Quality Control System Manager (PQCSM), Mr. Michael Sides, reports directly to the HLA PM  
17 and is responsible for the development and implementation of all delivery order documents and activities  
18 as well as for schedule and contract management, technical oversight, report generation, implementation  
19 of QC activities, and overall project quality. The PQCSM's specific responsibilities are as follows:

- 20 • Ensures that SOPs are available for activities that affect data quality and that assigned staff have been  
21 trained in their implementation
- 22 • Prepares and approves the WIP and DQOs identified within
- 23 • Ensures that appropriate sample preservation, handling, transport and custody are followed  
24 throughout the project
- 25 • Ensures that appropriate sampling, testing and analysis procedures are followed and that correct QC  
26 checks are implemented
- 27 • Monitors subcontractors and analytical laboratories for compliance with data quality requirements
- 28 • Reviews and approves calculations to ensure that data reduction is performed in a manner that  
29 produces quality data
- 30 • Verifies data quality, test results, equipment calibrations, and QC documentation
- 31 • Reviews and evaluates data generated for the project
- 32 • Reports QA problems to the McClellan AFB Project Manager and PKOP Contracting Officer
- 33 • Ensures that all key decisions and project deliverables are subjected to independent technical review,  
34 as scheduled



- 1 • Supervises the preparation of the final report.

2 **8.3.4 Field Quality Control Manager**

3 HLA's Field Quality Control Manager (FQCM), Mr. Alfonso Ang, is responsible for quality control of field  
4 operations, data collection, laboratory activities, and implementation of quality control. This position  
5 reports directly to the HLA PM. The FQCM's specific responsibilities are as follows:

- 6 • Provides coordination between field technicians and the other participants who are not directly  
7 involved in the sampling activities
- 8 • Implements the WIP
- 9 • Supervises field technicians who use SOPs for the purpose of QC and attainment of DQOs
- 10 • Ensures the proper use of SOPs associated with data collection and equipment operation
- 11 • Supervises sample collection and sample logging, and the recording of field tests and measurements
- 12 • Ensures that the proper number and type of environmental and control samples are collected,  
13 identified, tracked, and sent to the laboratory for analysis
- 14 • Provides oversight of all subcontractors who are supporting field activities
- 15 • Monitors field service subcontractors' performance of tasks, records cost and progress of the work,  
16 replans and reschedules work tasks as appropriate, and reports site progress status to the SM
- 17 • Coordinates and schedules sample shipment to analytical laboratories to meet holding times and  
18 analytical procedure specifications
- 19 • Coordinates the transfer of field data, sample tracking logs, and log books to the HLA PM for data  
20 reduction and validation.

21 **8.3.5 Program Safety and Health Officer**

22 The Program Safety and Health Officer is a Certified Industrial Hygienist, who is responsible for site safety  
23 and health for personnel working on the project, including implementation of the Safety and Health Plan  
24 and contractor safety and health training. The HLA Safety and Health Officer for this contract is  
25 Christopher Corpuz, who's specific responsibilities are as follows:

- 26 • Supervises field technicians regarding Health and Safety requirements
- 27 • Ensures that all field personnel and subcontractors at the site are familiar with the Health and Safety  
28 Plan and meet training requirements.

### 8.3.6 Project Chemist

The Project Chemist possesses knowledge of and experience with environmental analytical chemistry methodologies as described in U.S. Environmental Protection Agency (EPA) Guidance Document SW-846 (EPA, 1994a) as well as with quality control procedures as applicable to environmental analytical chemistry. The Project Chemist, Mr. Anthony Blake, is responsible for development of the QAPP and management of project tasks associated with sampling and preservation requirements, general oversight of field personnel in sampling activities, coordination of sample collection and analysis with the analytical laboratory, review of analytical data as it is reported, and implementation of QC activities and corrective actions (as necessary). The HLA Project Chemist specific responsibilities are as follows:

- Serves as the primary internal contact for all QA matters on the project
- Communicates and coordinates with the client, as necessary
- Responds to QA needs, resolves problems, and answers requests for guidance or assistance
- Provides guidance to HLA PM in the development of the WIP
- Reviews the implementation of the WIP and the adequacy of the data generated from a quality and data integrity perspective.

### 8.4 Data Quality Objectives

The overall data quality objectives (DQOs) for the PRDA test are to provide data of sufficient quality to properly evaluate the

- Innovativeness, importance and relevancy of FBA
- Cost effectiveness of FBA
- Mass removal capabilities of FBA.

Each of these broad objectives is described in terms of specific measurable quantities in Section 4.2. The analytical DQOs are based upon the data needs to meet the specific project objectives. Data quality is assessed in terms of the precision, accuracy, representativeness, comparability, and completeness (PARCC) of the data. Therefore, the data must meet minimum PARCC criteria to minimize the possibility of making incorrect decisions based upon insufficient data quality. The DQOs, as defined and assessed by these PARCC parameters, are discussed below.

The analytical DQOs for laboratory and field analytical methods used for this project are presented in Table 7. The required reporting limits for each analyses are presented in the SOPs (Appendix C).

#### 8.4.1 Precision

Precision measures the reproducibility of repetitive measurements; precision DQOs for the FBA Test are presented in Table 7. Analytical precision is a measurement of the variability associated with duplicate (two) analyses of the same sample in the laboratory and is determined by analysis of laboratory duplicates. Total precision is a measurement of the variability associated with the entire sampling and

analysis process. It is determined by the analysis of duplicate samples, and incorporates variability introduced by the analytical procedure, sample collection and handling, and matrix factors. Precision is assessed by taking into consideration these possible sources of variability. Precision is expressed as the relative percent difference (RPD) for comparison of two duplicates; the lower this value is, the more precise that data:

$$\text{RPD (\%)} = (|S - D| \times 100) / [(S + D) / 2]$$

where

D = Concentration of an analyte in a duplicate sample

S = Concentration of an analyte in a sample

#### **8.4.2 Accuracy**

Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systematic error; analytical accuracy DQOs for the FBA Test are presented on Table 6. Accuracy reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from the true value or known concentration. For the FBA Test, accuracy will be expressed as the percent recovery for standard calibration checks. The closer this value is to 100, the more accurate the associated data. This quantity is defined as follows:

$$\text{Percent Recovery} = (MC/KC) \times 100$$

where:

KC = Known concentration of an analyte

MC = Measured concentration of an analyte

#### **8.4.3 Representativeness**

Representativeness is a qualitative determination of the degree to which data accurately and precisely represents the actual environmental condition. Representativeness, in part, will be achieved by use of standard sampling and analytical procedures that have been accepted to provide representative data from other similar processes. The variability of the weekly operations samples will also provide an indication of the representativeness of the analytical results.

#### **8.4.4 Completeness**

Completeness indicates whether a sufficient number or percentage of valid measurements were obtained. The closer this value is to 100, the more complete the measurement process. The completeness goal for this project is 90 percent for each method. This quantity will be calculated as follows:

$$\text{Completeness (\%)} = (V/P) \times 100$$

where:

V = Number of valid measurements

P = Number of planned measurements

Valid measurements are those data points which are usable to meet the project objectives. This may include results qualified as estimated.

#### 8.4.5 Comparability

Comparability indicates the confidence with which one set of data can be compared to another. To determine if the FBA system will be effective at McClellan AFB, data quality must be comparable to data previously submitted during site remediation and the current cat-ox operations. VOC methods similar to those currently used at IC 31 are proposed and similar QC requirements will be implemented. The degree to which these QC requirements are met will indicate whether the data is comparable.

### 8.5 Analytical Procedures and Calibration

The analytical method standard operating procedures (SOPs) for vapors & emissions, water & product condensate, and resin beads are presented in Appendix C.

#### 8.5.1 QC Procedures

The specific QC samples associated with the methods for VOCs and NMOCs, and the frequency of collection and analysis are documented in each analytical method SOP. Descriptions of the purpose and frequency of the laboratory QC samples analyzed during the FBA test follow:

**Calibration Standards.** Initial calibration is performed as required for each analytical method, using a range of calibration standards containing all analytes with the lowest standard at or near the quantitation limit for the analyte. These standards are used to determine the calibration range of the instrument. The reported concentration of an analyte in a sample, or diluted sample must not exceed the calibration range determined by the highest concentration of the initial calibration standards. Method-specified acceptance criteria are met before the instrument is used to analyze field samples. Initial calibrations will be performed at the beginning of the project, when calibration checks fail, and following significant instrument maintenance.

Continuing calibration verification standards (CCV) containing all analytes are analyzed daily prior to sample analysis and after every 10 samples to verify that the initial calibration curve or response factors demonstrate acceptable performance of the analytical instrument. The results of the CCVs must meet the accuracy acceptance criteria before sample analysis proceeds.

**Method Blanks.** A method blank is a sample composed of all the components used in preparing a sample for analysis. It is carried through the same sample preparation procedure as a sample. Method blanks are used to ensure that interferences from the analytical system, gases, and glassware are minimized.

For gas phase analyses, a method blank (or system blank) is a sample of ultrapure inert gas that is carried through the entire analytical scheme. The blank is from the same source that is used to dilute the samples. A method blank analysis is performed daily and immediately after analysis of any sample that exhibits high analyte concentrations.

The concentration of any analyte in a method blank must be less than the reporting limit. The corrective action for method blanks that exceed allowable concentrations is to reanalyze the blank; if contamination still exceeds allowable concentrations, the source of contamination must be identified and corrected, and the blank and all associated samples are then reanalyzed.

**Laboratory Duplicates (Duplicate Analyses).** Laboratory duplicates are repeated but independent measurements of the same sample under the same conditions. The sample is split in the laboratory and each fraction is carried through all stages of sample preparation and analysis. The relative percent difference (RPD) between duplicate analyses is used to assess precision for each analytical method. Laboratory duplicates will be analyzed at a minimum of 10 percent of samples collected.

### **8.5 Sample Designation**

The sample numbering scheme has been developed to easily identify the location of each sample and calculate DRE during the FBA system pilot test. Samples will be identified according to the sample identification scheme specified in Table 8. Influent and effluent samples collected on the same day with the same set of conditions will both contain the same xx portion of the sample number to denote influent/effluent sample pairs for DRE calculations using laboratory analyses.

### **8.7 Data Reduction, Validation, and Reporting**

This section describes the procedures to validate the laboratory data. HLA data validation procedures are based on EPA functional guidelines for organic and inorganic data review (EPA, 1993, 1994b). QA/QC information will be compared to the acceptance criteria. Results of the data validation are recorded on worksheets that will be summarized in the final report. These worksheets will indicate the QA/QC results and the appropriate control limits. One hundred percent of the laboratory-generated data will be subjected to the routine review of each of the following:

- Laboratory reports and chain of custody documentation to check for errors and omissions.
- Laboratory case narratives to check for anomalies and exceedances of QA/QC requirements.
- Laboratory reports to check for correct reporting limits and units.
- Extraction and analysis holding times.
- Method blank, trip blank, equipment blank, and rinse water blank data. Note any detected analytes and their respective concentrations.
- Surrogate compounds, their spiking levels, the reported concentrations, and the percent recoveries.
- MS/MSD samples, their spiking levels, reported concentrations, percent recoveries, and relative percent differences between the MS and MSD.
- Laboratory control samples, their spiking levels, determined concentrations, and percent recoveries.
- Laboratory duplicate samples, field duplicate samples, and relative percent differences.

### **8.8 Internal Quality Control Checks**

The project team members will be responsible for implementation of their respective QA roles, as described in Section 8.3 of this document. The Project Manager will have ultimate responsibility for checking that each project team member is providing their required QC activities.

## **8.9 Performance and System Audits**

Performance and system audits will be conducted during bi-weekly meetings and electronic mail communications among the project team members. Project status and associated QA/QC requirements will be outlined and discussed to reiterate the responsibilities of each team member. Response time and the scheduling of activities will be coordinated to maintain compliance with the contract schedule.

## **8.10 Data Qualifiers**

When the data validation indicates that a control parameter is not within the limits specified in this QAPP, qualifiers will be applied to the analytical data to indicate the usability of the data. These qualifiers are defined in Table 9. The qualifier application process, indicated in Table 10, defines the manner in which exceedances of QA/QC parameters will be treated and how qualifiers will be applied.

Following completion of the data validation effort and application of data qualifiers, the HLA Project Chemist will report the data validation results to the HLA data user or decision maker (e.g., the Task Manager or Project Manager). This reporting process includes a discussion of data usability. In general, the usability of the data and resolution of issues associated with QC results outside of data quality objectives is dependent on the degree of the exceedance, whether the potential measurement bias is high or low, and whether the uncertainty implied by the exceedance is significant relative to project- or site-specific decision levels and data quality objectives. Data usability is also evaluated by the decision maker through the use of professional judgment or statistical tests designed to identify outlier data or anomalous results.

## **8.11 Analytical Laboratory Requirements**

The analytical laboratory will be state certified to conduct the chemical analyses summarized in this document in accordance with the QC guidance presented in this QAPP and attached SOPs.

## **9.0 HEALTH AND SAFETY PLAN**

### **9.1 Introduction and Objectives**

A detailed Health and Safety Plan (HASP) is attached in Appendix B to provide safety protocol for implementation of the PRDA FBA Test.

### **9.2 Health and Safety Organization and Key Personnel**

See Appendix B, Sections 2.1 and 2.2.

### **9.3 Hazard Assessment**

See Appendix B, Sections 1.2, 1.3, and 5.0.

### **9.4 Engineering Controls**

See Appendix B, Section 6.1.

### **9.5 Personnel and Subcontractor Training**

See Appendix B, Section 3.0.

### **9.6 Site Monitoring**

See Appendix B, Sections 5.0 and 7.0.

### **9.7 Medical Surveillance Requirements**

See Appendix B, Section 4.0.

### **9.8 Decontamination Procedures**

See Appendix B, Section 8.2.

### **9.9 Emergency Contacts**

See Appendix B, Table 3.

## **10.0 SCHEDULE**

The FBA Test schedule is presented as an Engineering Network Analysis on Plate 7.



## **11.0 MANAGEMENT AND STAFFING**

HLA will manage the PRDA FBA test from our Bay Area Complex where the engineering staff is most familiar with the FBA test unit. The field technician for monitoring operations will be staffed from our Sacramento office to provide quick response to alarm conditions at the site. The key members of the project team are presented on Plate 3.

## 12.0 REFERENCES

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## TABLES

Table 1. Chemicals of Concern  
Fluidized Bed Adsorption PRDA Test  
Work Implementation Plan  
McClellan Air Force Base, IC-31  
Sacramento, California

Compound	Detected Concentration at Well VW5001 on 12/20/96 (ppmv)	Range of Detected Concentrations during Cat Ox Operations at IC 31 as of 1/8/97	
		Concentration (ppmv)	Source
1,1,1-Trichloroethane	5.5	5.5 - 10	1
1,1-Dichloroethane	ND	2.7 - 0.73	2
1,1-Dichloroethene	13	280 - 13	1
1,2-Dichloroethane	ND	2.7 - 0.16	2
Acetone	ND	1.1 - 0.65 [a]	3
Benzene	7.0	710 - 7.0	1
Carbon Tetrachloride	3.1	10 - 3.1	1
Chloroform	ND	5.7 - 1.2	2
cis-1,2-Dichloroethene	5.4	410 - 5.4	1
Ethyl Benzene	ND	24 - 9.2	2
m,p-Xylene	ND	12 - 7.3	2
Methylene Chloride	ND	58 - 0.21	2
o-Xylene	ND	8.4 - 1.3	2
Tetrachloroethene	ND	4.1 - 0.03	3
Toluene	ND	0.22 - 0.064	3
Freon 113	ND	0.17 - 0.006	3
Trichloroethene	70	1500 - 70	1
Vinyl Chloride	ND	0.067 - 0.007	3
Non-Methane Organic Compounds (as methane)	12,000	68,000 - 12,000	1

Information presented in this table is based on IC 31 data provided by McClellan AFB.

Notes:

1 = Data recorded in samples from soil vapor extraction well VW-5001

2 = Influent concentration to CatOx and not visible at VW-5001

3 = Effluent concentration from CatOx (increased by a factor of 10 to represent soil vapor extraction well VW-5001 well data)

ND = Not detected above laboratory reporting limits

ppmv = parts per million by volume

[a] = Range for laboratory results for 11/07/96 to 1/8/97 only

Table 2. Operation, Maintenance, and Shutdown Log  
 Fluidized Bed Adsorption PRDA Test  
 Work Implementation Plan  
 McClellan Air Force Base, IC-31  
 Sacramento, California

System Status: Running/Not Running (circle one)

Recorder's Name(s): \_\_\_\_\_

Date: \_\_\_\_\_

	PID calibrated with 100 ppmv isobutylene? (yes/no)	System Measurements					Operational Parameter			
		Time	Hour meter (hours)	Inlet temp. (deg. F)	Venturi Meter (in. H2O)	Vac. upstream of Venturi Meter (in. H2O)	Condensate Drum (gallons)	PID measurements @ . . . .		Blower Current Draw (Amps)
								Influent (ppmv)	Effluent (ppmv)	
								Time		
FBAS										

### Shutdown log

Was Shutdown Planned or Unplanned (Circle one)
Shutdown Time (Hour Meter Reading):
Restart Time :
Purpose of Planned Shutdown:
Cause of Unplanned Shutdown:
Corrective Actions Required or Recommended (circle one):
By:
Corrective Action(s) Completed:
By:
Observation/Notes

Table 3. Utility Requirements  
 Fluidized Bed Absorption PRDA Test  
 Work Implementation Plan  
 McClellan Air Force Base, IC-31  
 Sacramento, California

Utility	Item	Requirement
Electrical Power	Extraction Blower FBA Test Unit 110v Outlet	230 volt, 1 phase, 26 amps 230 volt, 3 phase, 70 amps 110 volt, 1 phase, 15 amps
Supply Water	Non-Contact Cooling Water	6 gallons per minute (gpm)
Discharge Water to IWL	Non-Contact Cooling Water	6 gallons per minute (gpm)
Collected Water Pending Discharge to IWL	Extraction Air/Water (Blower Moisture) Separator	As needed (up to 20 gallons per week)
Telephone	Autodialer	1 line

IWL = McClellan AFB Industrial Wastewater Line

- Notes: 1. Collected Water Pending Discharge to IWL will be combined with water collected from other air-water separators at IC-31 for handling and processing.
2. HLA will provide telephone service for FBA test.

Table 4. Sampling Schedule  
Fluidized Bed Adsorption PRDA Test  
Work Implementation Plan  
McClellan Air Force Base, IC-31  
Sacramento, California

Parameter	Method	Sample Location	HIGH INFLUENT CONCENTRATION PERIOD										LOW INFLUENT CONCENTRATION PERIOD					Laboratory Analyses Total																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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\* Sampling event may involve multiple measurements on any given field visit.  
 \*\* Sample will be composited from each condensate drum to obtain representative sample. Actual sample date may vary.  
 FB = Field Blank  
 FBAE = Fluidized Bed Adsorption Effluent  
 FBAI = Fluidized Bed Adsorption Influent  
 FD = field duplicate  
 NMOCs = non-methane organic compounds  
 PID = photoionization device  
 QC = quality control  
 TICs = tentatively identified compounds  
 TPH = total petroleum hydrocarbons  
 TPHe = TPH using purgeable recovery method for VOCs  
 TPHe = TPH using extractable recovery method for VOCs  
 TVH = total volatile hydrocarbons  
 VOCs = volatile organic compounds  
 SOC's = semi-volatile organic compounds

Table 5. Sample Containers Holding Times  
 Fluidized Bed Adsorption PRDA Test  
 Work Implementation Plan  
 McClellan Air Force Base, IC-31  
 Sacramento, California

Parameter	Analytical Method	Sample Container	Holding Time	Preservation
<b>VAPORS &amp; EMISSIONS</b>				
Halogenated and Aromatic VOCs and NMOCs	8021 and E18 modified	Tedlar (R) bag	24 hours	None
VOCs	Method TO-14	SUMMA (R) Canister	14 days	None
Nitrogen Oxides	CARB 100	Continuous Monitor	As collected	None
<b>WATER CONDENSATE</b>				
Halogenated and Aromatic VOCs	EPA 8240	40-ml VOA Vial (3)	14 days	None
TPH	EPA 3510/8015 modified	Amber Liter (2)	7 days	None
Acidity	EPA 9040	Poly 0.5 Liter (2)	24 hours	None
<b>PRODUCT CONDENSATE</b>				
Halogenated and Aromatic VOCs	EPA 8240	40-ml VOA Vial (3)	14 days	None
TPH	EPA 3510/8015 modified	Amber Liter (2)	7 days	None
<b>RESIN BEADS</b>				
Halogenated and Aromatic VOCs	EPA 8240	8-oz Glass Jar (2)	14 days	None
TPH purgable	EPA 5030/8015 modified	8-oz Glass Jar (2)	14 days	None
TPH extractable	EPA 3550/8015 modified	8-oz Glass Jar (2)	14 days	None



Table 6. Rationale for Vapor and Emissions Analytical Methods  
Fluidized Bed Adsorption PRDA Test  
Work Implementation Plan  
McClellan Air Force Base, IC-31  
Sacramento, California

Phase	Analytical Method	Data Quality Level		Rationale Based Upon Data Use
		EPA DQO Guidance	Basewide RI/FS QAPP	
Startup	Total VOCs (Field PID readings)	Screening	Level I	1) Immediate TAT to support FBA optimization.
	Halogenated and Aromatic VOCs and NMOCs (8021 and E18 modified)	Screening	Level II	1) Short TAT to support FBA optimization. 2) Provides some speciation and correlation for PID readings
Test	Total VOCs (Field PID readings)	Screening	Level I	1) Immediate TAT to monitor any changes in FBA system
	Halogenated and Aromatic VOCs and NMOCs (8021 and E18 modified)	Screening	Level II	1) Short TAT to monitor changes in FBA system 2) Provides some speciation and correlation for PID readings 3) Verification samples will also be collected and analyzed by Method TO-14 for more definitive VOC emissions.
	VOCs (Method TO-14)	Definitive	Level III	1) Standard method for producing high quality data for total and speciated emissions. 2) Can tentatively identify intermediate compounds or byproducts.
	Nitrogen Oxides (CARB 100)	Definitive	Level III	Monitor Nitrogen Oxides emission as a criteria pollutant using acceptable CARB method.

EPA DQO Guidance = 1993 EPA Data Quality Objectives Interim Final Guidance

Table 7. Analytical Data Quality Objectives  
Fluidized Bed Adsorption PRDA Test  
Work Implementation Plan  
McClellan Air Force Base, IC-31  
Sacramento, California

Analysis	Reference Method	Basewide RI/FS QAPP Table References for Applicable Analytical Data Quality Objectives
<b>VAPORS &amp; EMISSIONS</b>		
VOCs	EPA Method 8021	4-5a, 4-5b, and 10-5
NMOCs	Modified Method E18	10-32
VOCs	EPA Method TO-14	4-2 and 10-27
Nitrogen Oxides	CARB 100	---
<b>WATER CONDENSATE</b>		
VOCs	EPA Method 8240[a]	4-11 and 10-11
TPHp	EPA 5030/8015 modified	4-6 and 10-6
TPHe	EPA 3550/8015 modified	4-7 and 10-7
Acidity	EPA Method 9040	---
<b>PRODUCT CONDENSATE</b>		
VOCs	EPA Method 8240[a]	4-11 and 10-11
TPHp	EPA 5030/8015 modified	4-6 and 10-6
TPHe	EPA 3550/8015 modified	4-7 and 10-7
<b>RESIN BEADS</b>		
VOCs	EPA Method 8240[a]	4-11 and 10-11
TPHp	EPA 5030/8015 modified	4-6 and 10-6
TPHe	EPA 3550/8015 modified	4-7 and 10-7

All referenced tables are from the Basewide Remedial Investigation/Feasibility Study Quality Assurance Project Plan dated April 1997

Notes: --- = not applicable

VOCs = volatile organic compound

NMOCs = non-methane organic compound

CARB = California Air Resource Board

EPA = U.S. Environmental Protection Agency

TO = toxic organics

TPHp = TPH using purgable recovery method

TPHe = TPH using extractable recovery method

[a] = Method 8240 has been replaced by Method 8260A. Collected samples will be analyzed by Method 8260A with applicable data quality objectives as specified in the Basewide RI/FS QAPP.

Table 8. Sample Identification Scheme  
 Fluidize Bed Adsorption PRDA Test  
 Work Implementation Plan  
 McClellan Air Force Base  
 Sacramento, California

Phase	Sample Location	Sample Identification Number [1]
Startup and Operation	Process Influent	FBAI - xx
Startup and Operation	Process Effluent	FBAE - xx
Startup and Operation	Desorber Resin Beads	DESORB - xx
Operation	Adsorber resin Beads	ADSORB - xx
Operation	Condensate Drum 1(water phase)	WCOND1 - xx
Operation	Condensate Drum 2 (water phase)	WCOND2 - xx
Operation	Condensate Drum 1 (product phase)	PCOND1 - xx
Operation	Condensate Drum 2 (product phase)	PCOND2 - xx
Startup and Operation	Field Duplicate	FBAD - xx
Startup and Operation	Field Blank	FBAB - xx

Notes : [1] = xx indicates consecutive numbers from the start of the performance test

Table 9. Data Validation Procedures  
Fluidized Bed Absorption PRDA Test  
Work Implementation Plan  
McClellan Air Force Base, IC-31  
Sacramento, California

Control Parameter	Exceedance of Control Limits	Qualification of Detected Results	Qualification of Nondetected Results	Associated Results
Holding Times (Volatile organic methods)	Holding time exceeded by 1 - 7 days	J-	J-	All method results in affected sample
	Holding time exceeded by > 7 days	J-	R	All method results in affected sample
Temperature Preservation	4° C > temperature < 9° C temperature > 9° C	J-	J-	All method results in affected sample
		J-	R	
Holding Times (Mercury and hexavalent Cr)	Holding time exceeded	J-	R	All method results in affected sample
Holding Times (All other methods)	Holding time exceeded	J-	J-	All method results in affected sample
Laboratory Blanks	Analyte detected in blank. Determine action level: multiply value by 10 for common lab contaminants or by 5 for other analytes	U detected results below action level	Not qualified	Analyte results in the analytical batch
Trip Blanks	Same as laboratory blanks	U detected results below action level	Not qualified	Analyte results in samples in the same cooler
Equipment Blanks	Same as laboratory blanks	U detected results below action level	Not qualified	Analyte results in samples in the same sampling event
Surrogate Recovery (GC, HPLC methods)	recovery > UCL	J+	Not qualified	All method results in affected sample
	LCL > recovery > 50%	J-	J-	
	recovery < 50%	J-	R	
Surrogate Recovery (GC/MS methods)	recovery > UCL	J+	Not qualified	All method results in affected sample
	LCL > recovery > 10%	J-	J-	
	recovery < 10%	J-	R	

Table 9. Data Validation Procedures  
Fluidized Bed Absorption PRDA Test  
Work Implementation Plan  
McClellan Air Force Base, IC-31  
Sacramento, California

Control Parameter	Exceedance of Control Limits	Qualification of Detected Results	Qualification of Nondetected Results	Associated Results
Laboratory Control Sample (LCS) Recovery (GC, HPLC methods)	recovery > UCL LCL > recovery > 50% recovery < 50%	J+ J- J-	Not qualified J- R	Analyte results in the analytical batch or sub-analytical batch
LCS Recovery (GC/MS methods)	recovery > UCL LCL > recovery > 10% recovery < 10%	J+ J- J-	Not qualified J- R	Analyte results in the analytical batch or sub-analytical batch
LCS Recovery (Inorganic methods)	recovery > UCL LCL > recovery > 50% recovery < 50%	J+ J- J-	Not qualified J- R	Analyte results in the analytical batch or sub-analytical batch
Matrix Spike/Matrix Spike Duplicate (MS/MSD) Recoveries (GC, HPLC methods)	recovery > UCL LCL > recovery > 50% recovery < 50%	J+ J- J-	Not qualified J- R	Analyte results in the analytical batch (1)
MS/MSD Recoveries (GC/MS methods)	recovery > UCL LCL > recovery > 10% recovery < 10%	J+ J- J-	Not qualified J- R	Analyte results in the analytical batch (1)
MS Recovery (Inorganic methods)	recovery > UCL LCL > recovery > 30% recovery < 30%	J+ J- J-	Not qualified J- R	Analyte results in the analytical batch (1)
MS/MSD RPD (Organic methods)	RPD > CL	J	J	Analyte results in the spiked sample
Matrix Duplicate RPD (Inorganic methods)	RPD > CL and sample and duplicate results > 5X PQL	J	J	Analyte results in the analytical batch (1)
	RPD > CL and sample and/or duplicate results < 5X PQL and difference > PQL	J	J	Analyte results in the analytical batch (1)

Table 9. Data Validation Procedures  
Fluidized Bed Absorption PRDA Test  
Work Implementation Plan  
McClellan Air Force Base, IC-31  
Sacramento, California

Control Parameter	Exceedance of Control Limits	Qualification of Detected Results	Qualification of Nondetected Results	Associated Results
Initial Calibration %RSD (Organic methods)	%RSD > CL or $r < 0.995$	J	J	Analyte results associated with the initial calibration
Initial Calibration RRF (GC/MS methods)	RRF < 0.05	J	R	Analyte results associated with the initial calibration
Continuing Calibration %D (Organic methods)	%D > UCL	J+	Not qualified	Analyte results associated with the continuing calibration
	$-50\% < \%D < \text{LCL}$	J-	J-	
	%D < -50%	J-	R	
Initial Calibration and Continuing Calibration Verification (ICV and CCV) Recoveries (Inorganic methods)	recovery > 125%	R	Not qualified	Analyte results associated with the ICV or CCV
	$125\% > \text{recovery} > \text{UCL}$	J+	Not qualified	
	$\text{LCL} > \text{recovery} > 75\%$	J-	J-	
	recovery < 75%	R	R	
Field Duplicate RPD (All Methods)	RPD > CL	Not qualified; discuss impact in report	Not qualified; discuss impact in report	Analyte results in the sample and duplicate
Internal Standard Area Counts (GC/MS methods)	Area counts > 2X the associated standard	J+	Not qualified	Associated analyte results in the sample
	Area counts < 0.5X the associated standard	J-	R	Associated analyte results in the sample

CL Control limit.

UCL Upper control limit.

LCL Lower control limit.

RPD Relative percent difference.

RRF Relative response factor.

%RSD Percent relative standard deviation of the response factors.

%D Percent difference between the continuing calibration RRF and the initial calibration RRF.

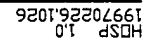
(1) If the spiked sample or duplicate is not considered representative of the analytical batch, only the sample is qualified.

Table 10. Qualifiers Applied During Data Validation  
 Fluidized Bed Absorption PRDA Test  
 Work Implementation Plan  
 McClellan Air Force Base, IC-31  
 Sacramento, California

Qualifier	Definition of Qualifier
A	Sample has undergone routine data validation.
J+	Data are qualified as estimated, with a high bias likely to occur. False positives or false negatives are unlikely to have been reported.
J-	Data are qualified as estimated, with a low bias likely to occur. False positives or false negatives are unlikely to have been reported.
J	Data are qualified as estimated; it is not possible to assess the direction of the potential bias. False positives or false negatives are unlikely to have been reported.
R	Data are qualified as rejected. There is a significant potential for the reporting of false negatives or false positives.
U	Data are qualified as nondetected, because the analyte was observed in an associated laboratory or field bl

**PLATES**





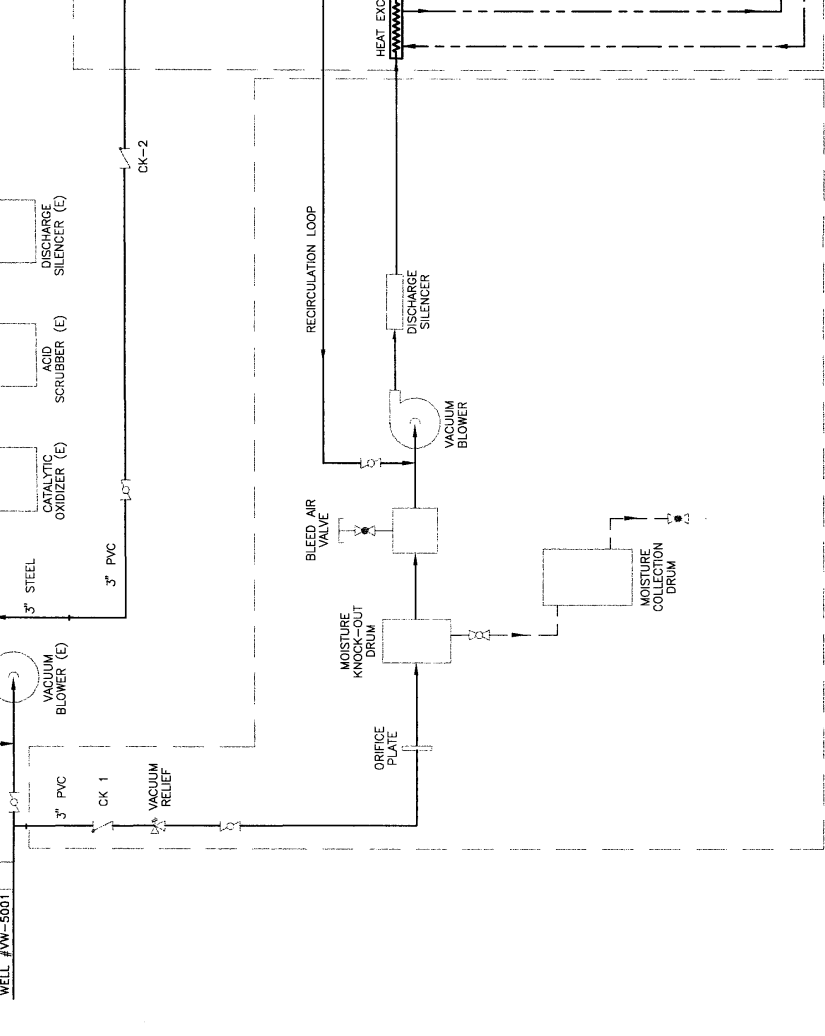
**Harding Lawson Associates**

**Engineering and Environmental Services**

**JOB NUMBER**  
**37478.14**

DRAWN  
TAG

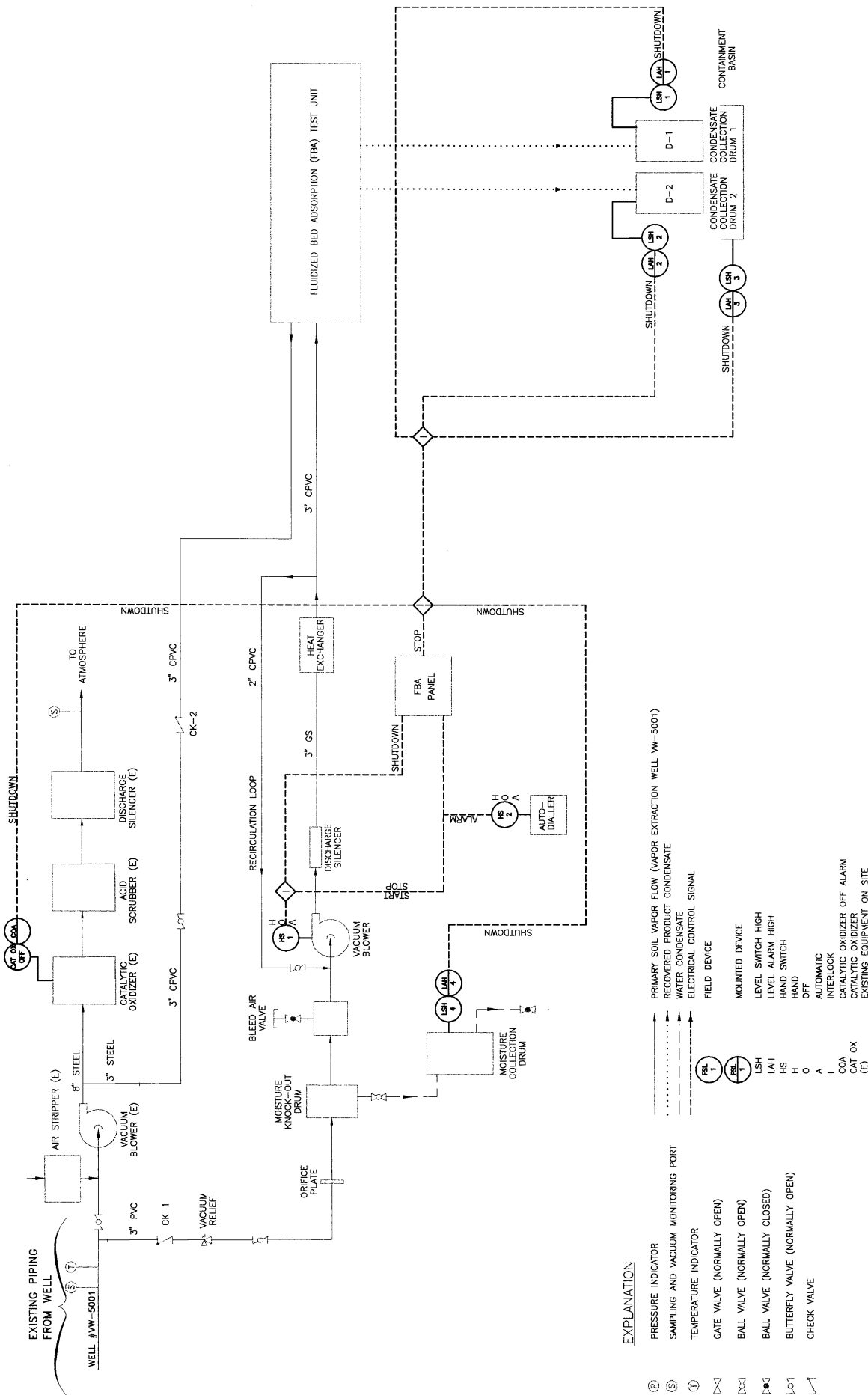
EXISTING PIPING FROM WELL  
WELL #VW-5001



EXPLANATION

- (P) PRESSURE INDICATOR
  - (S) SAMPLING AND VACUUM MONITORING PORT
  - (T) TEMPERATURE INDICATOR
  - D-1 GATE VALVE (NORMALLY OPEN)
  - D-2 BALL VALVE (NORMALLY OPEN)
  - D-3 BALL VALVE (NORMALLY CLOSED)
  - D-4 BUTTERFLY VALVE (NORMALLY OPEN)
  - L-1 CHECK VALVE
- PRIMARY SOIL VAPOR FLOW (VAPOR EXTRACTION WELL VW-5001)  
 FLUIDIZED POLYMERIC RESIN BEAD FLOW  
 TRANSFER GAS  
 RECOVERED PRODUCT CONDENSATE  
 WATER CONDENSATE  
 NON-CONTACT COOLING WATER OR HEATER OIL  
 SKID OR TRAILER-MOUNTED EQUIPMENT PACKAGE  
 MCCLELLAN AFB IWL  
 MCCLELLAN AIR FORCE BASE INDUSTRIAL WASTEWATER LINE  
 EXISTING EQUIPMENT ON SITE

A. 5/27 DESIGN SUBMITTAL		PROJECT NO. 37478.21		DRAWN: TAG		SCALE: NO SCALE		ENGINEER: AA		CHECKED: MAS		DATE: 4/97		Harding Lawson Associates Engineers and Environmental Services 90 Capitol Mall, Suite 200 Sacramento, CA 95814 Phone (916) 483-0112		FLUIDIZED BED ADSORPTION PRDA TEST		PROCESS FLOW DIAGRAM FBA PRDA TEST		PLATE: 2	
NO. DATE		BY		CHK		DATE		REVISIONS		SHEET: 1 OF 4		REVISION NUMBER: 0		DATE: 5/97							



EXPLANATION

- (P) PRESSURE INDICATOR
- (S) SAMPLING AND VACUUM MONITORING PORT
- (T) TEMPERATURE INDICATOR
- (V) GATE VALVE (NORMALLY OPEN)
- (V) BALL VALVE (NORMALLY OPEN)
- (V) BALL VALVE (NORMALLY CLOSED)
- (V) BUTTERFLY VALVE (NORMALLY OPEN)
- (V) CHECK VALVE

- (P) PRIMARY SOIL VAPOR FLOW (VAPOR EXTRACTION WELL VW-5001)
- (S) RECOVERED PRODUCT CONDENSATE
- (T) WATER CONDENSATE
- (V) ELECTRICAL CONTROL SIGNAL
- (V) FIELD DEVICE
- (V) MOUNTED DEVICE
- (V) LEVEL SWITCH HIGH
- (V) LEVEL ALARM HIGH
- (V) HAND SWITCH
- (V) HAND OFF
- (V) AUTOMATIC
- (V) INTERLOCK
- (V) CATALYTIC OXIDIZER OFF ALARM
- (V) CATALYTIC OXIDIZER
- (V) CAT OX
- (V) EXISTING EQUIPMENT ON SITE

NO. DATE	BY	CHK	DATE

REVISIONS

DESIGN	DATE	BY	CHK	DATE
A 5/97	3747821			

Harding Lawson Associates  
Environmental Services  
9000 1st Ave.  
Sacramento, CA 95811  
Phone (916) 486-0115

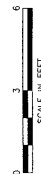
FLUIDIZED BED ADSORPTION PRDA TEST  
TEST SITE LOCATION  
McCLELLAN AIR BASE  
SACRAMENTO, CALIFORNIA

INSTRUMENTATION DIAGRAM  
FBA PRDA TEST

PLATE 3  
SHEET 2 OF 4  
REVISION NUMBER 0  
DATE 5/97

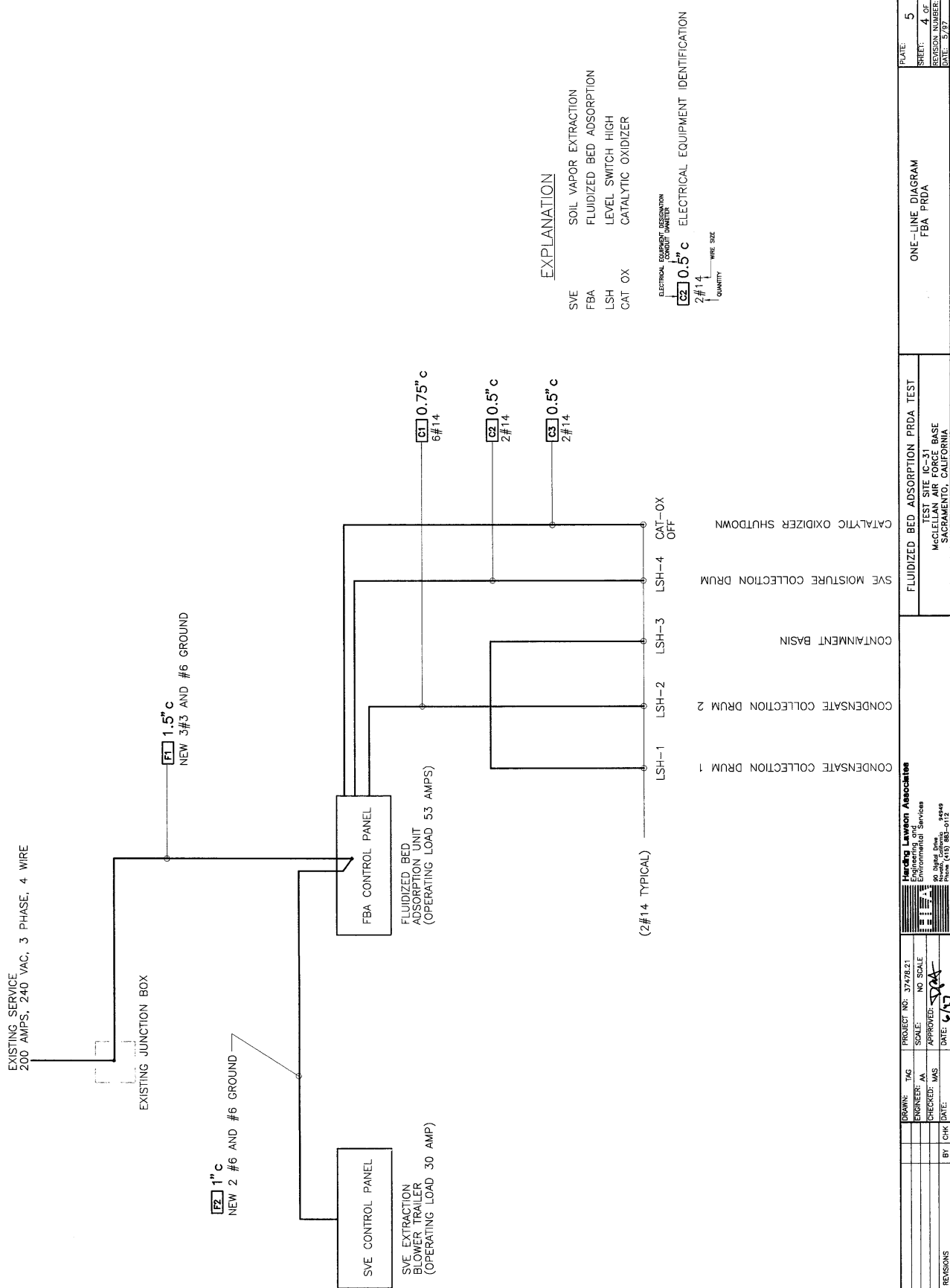
- 1) ALL CONDUIT TO BE EMT TYPE WITH COMPRESSION FITTINGS. USE LIQUID FLEX TYPE CONDUIT FOR ALL CONNECTIONS TO DEVICES.
- 2) WIRE SHALL BE TYPE THWN/THHN STRANDED COPPER SIZE AND QUANTITY AS SHOWN ON ONE LINE DIAGRAM.
- 3) MAINTAIN 3" CLEARANCE BETWEEN ELECTRICAL SUPPLY BOX AND ALL PIPING JOINTS AND EQUIPMENT.

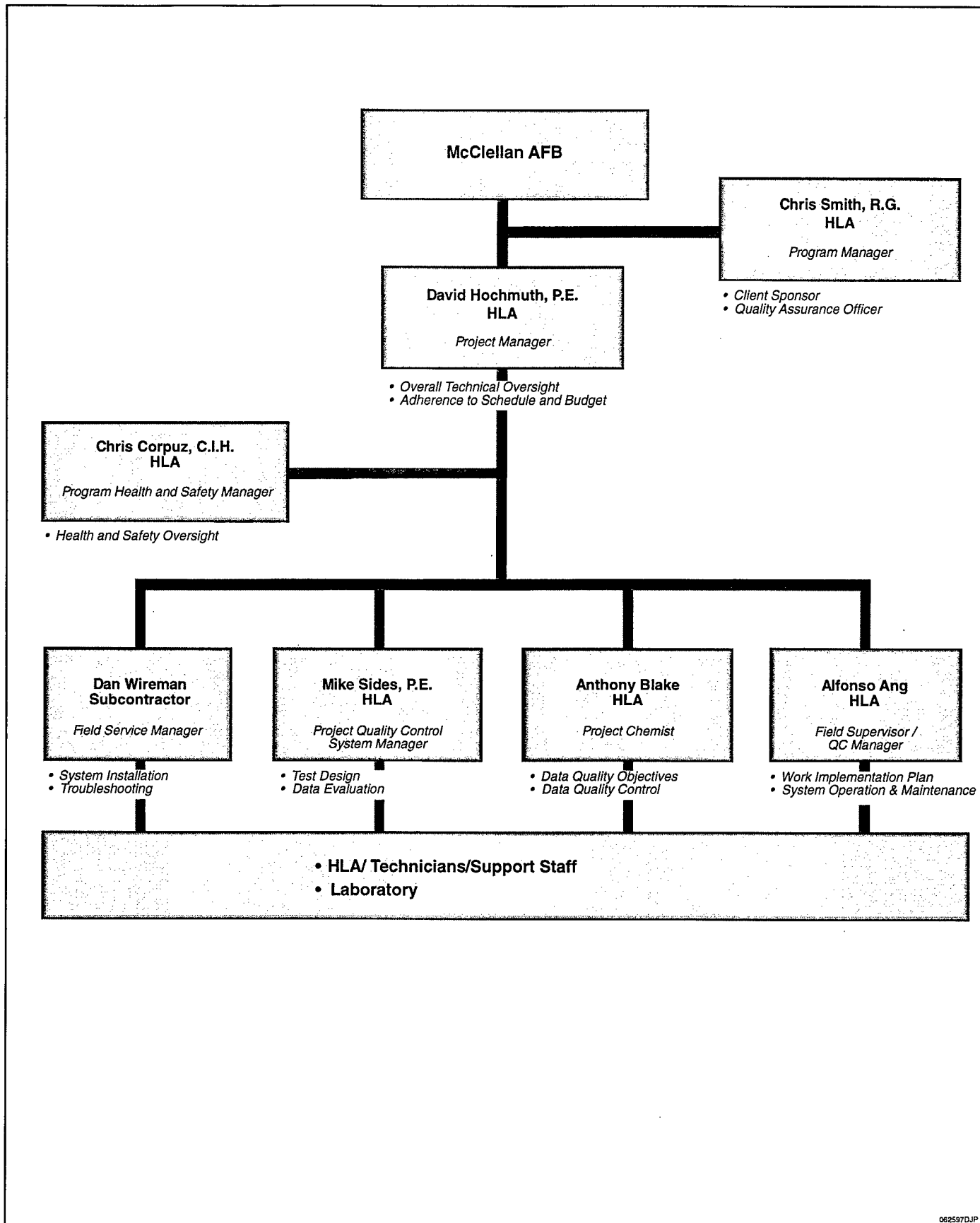
UNUSV	UNTREATED SOIL VAPOR
TSV	TREATED SOIL VAPOR
PVC	POLYVINYL CHLORIDE PLASTIC
CPVC	CHLORINATED POLYVINYL CHLORIDE PLASTIC
FBA	FLUIDIZED BED ADSORPTION
TH	FLEXIBLE HOSE
TW	TAP WATER
SS	GALVANIZED STEEL
C	COPPER
WC	WATER CONDENSATE
(E)	EXISTING EQUIPMENT ON SITE
N	NITROGEN
MCLELLAN AFB IWL	MCLELLAN AIR FORCE BASE INDUSTRIAL WASTEWATER LINE
---	FBA TEST PIPING
---	EXISTING PIPING
---	ELECTRICAL CONDUIT
+	JUNCTION BOX

[illegible]

FLUIDIZED BED ADSORPTION PRDA TEST

PLATE: 4  
SHEET: 3 OF 3  
REVISION NUMBER:  
DATE: 5/97





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**Harding Lawson Associates**  
Engineering and  
Environmental Services

**Project Organization Chart**  
Work Implementation Plan  
McClellan AFB  
Sacramento, California

PLATE

**6**

DRAWN  
CNC

JOB NUMBER  
37478 22

APPROVED

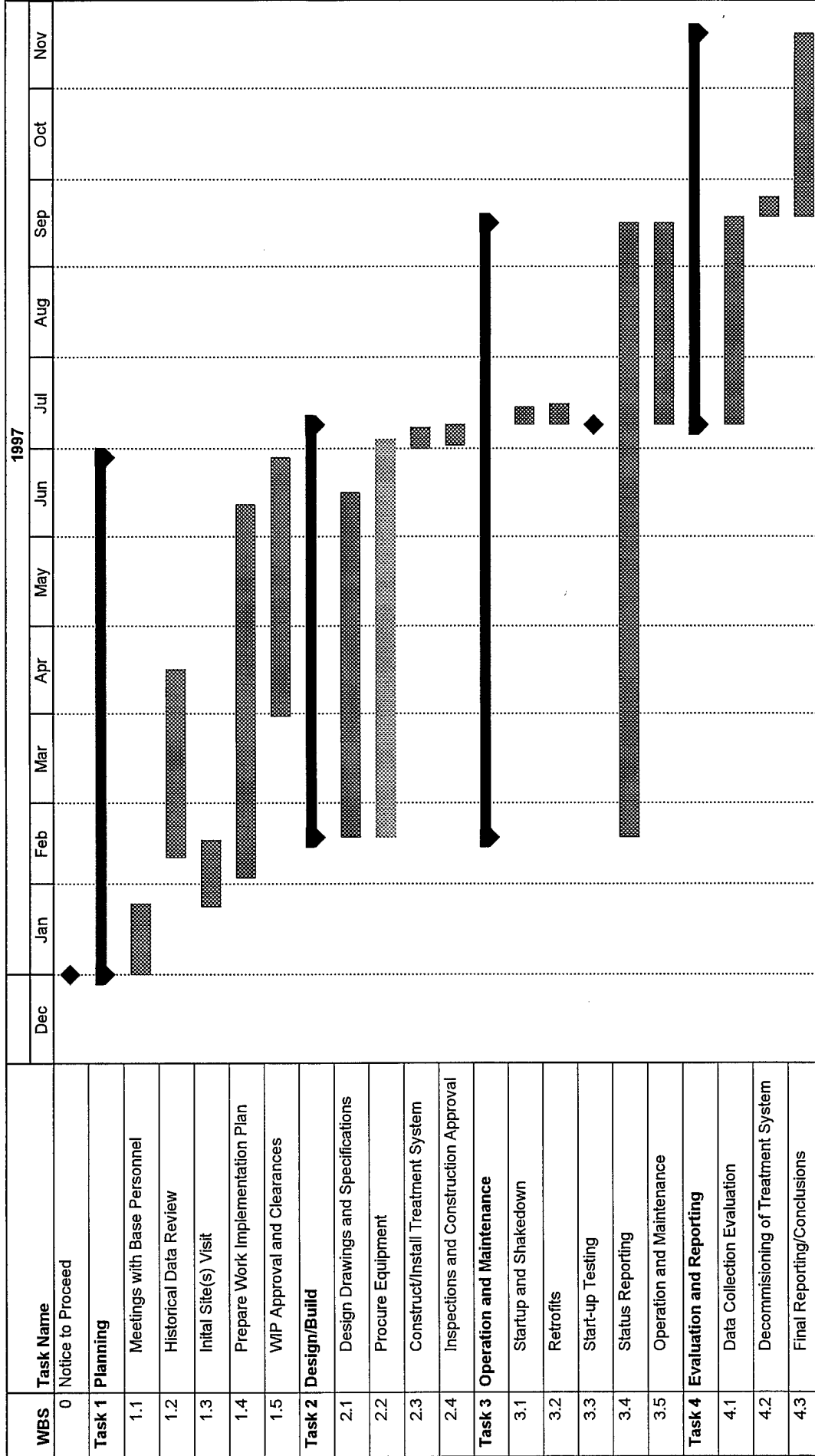
*[Signature]*

DATE  
6/97

REVISED DATE

Plate 7 Engineering Network Analysis  
 McClellan Air Force Base  
 Program Research and Development Announcement

Harding Lawson Associates  
 Fluidized Bed Adsorber Pilot Test



**APPENDIX A**  
**VOC CONCENTRATION SUMMARY TABLES**



# VOC Concentrations Summary Table

McClintan AFB, Site KC 31

QUERY SEARCH START DATE: 8/18/83  
QUERY SEARCH END DATE: 11/02/86

SEARCH PARAMETERS: LOCATION ALL ANALYSIS ALL

VOC CONCENTRATIONS (ppmv)

MMOC's

Sample ID	Sample Location	Analysis Method	Lowest MRL	FC12	CLME	VC	FC11	DCE11	FC113	MILNCL	DCE12	DCA11	DCE12C	TC1ME	TC111	CTCL	DCA12	BZ	TCE	BZME	PCE	CLBZ	EBZ	XYLMP	XYLO	Methylene	TPH
AS@KC31	4040	TO14	0.0008							0.43						0.001										MC	0.436
AS@KC31	4038	TO14	0.0003	0.0004						0.0019																MC	0.00493
CO1	3444	8021	0.43					32																		MC	12000
CO1	3845	TO14	5.6					28		56																MC	96000
CO1	3831	8021	0.13					0.73																		MC	13000
CO1	3932	TO14	5.7					40																		MC	12890
CO1	4020	8021	0.23					13																		MC	110000
CO1	4021	TO14	0.1					52																		MC	13000
CO1	4032	8021	0.25					16																		MC	17000
CO1	4033	TO14	4					55																		MC	833
CO1	4044	TO14	2.1					11																		MC	16000
CO1	4175	8021	0.23					37		3.6																MC	15000
CO1	4176	TO14	8.3					33																		MC	2000
CO1	4220	8021	0.15					25		6.5																MC	12000
CO1	4240	8021	0.15					28		7																MC	833
CSE	3852	8021	0.0075					0.74																		MC	16000
CSE	3853	TO14	0.068					0.88																		MC	13000
CSE	3923	8021	0.01					1.2																		MC	15000
CSE	3924	TO14	0.15					1.7																		MC	7200
CSE	4032	8021	0.01					0.13																		MC	340
CSE	4033	TO14	0.1					1.5																		MC	240
CSE	4037	8021	0.012					0.086		0.03																MC	30.98
CSE	4038	TO14	0.14					1.8																		MC	270
CSE	4177	8021	0.31					1.9																		MC	320
CSE	4178	TO14	0.31					1.7																		MC	330
CSE	4221	8021	0.0078					0.04																		MC	360
CSE	4249	8021	0.0078					0.031																		MC	380
CSE	4024	TO14	0.1					1.7																		MC	44.01
EB@5032	3809	8021	0.003					0.003																		MC	160
EB@5032	3715	TO14	0.002					0.002																		MC	0.0038
EB@5031	3825	8021	0.003					0.003																		MC	480
EB@5053	3741	8021	0.003					0.003																		MC	40.3
EB@5073	3738	8021	0.003					0.003																		MC	0
TR@KC31	3753	TO14	0.002					0.002																		MC	78000
VPK-501-01	3600	8021	3600					360																		MC	45000
VPK-501-01	3703	TO14	22					300																		MC	140000
VPK-501-01	3804	8021	0.75					340																		MC	270000
VPK-501-01	3805	8021	3					340																		MC	110000
VPK-501-02	3709	8021	1500					310																		MC	27000
VPK-501-02	3808	8021	18					0.7																		MC	27000
VPK-501-03	3896	8021	1500					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0.7																		MC	27000
VPK-501-03	3907	8021	0.3					0																			

Table 1																											
VOC Concentrations Summary Table																											
McClintock AFB, Site MC 31																											
VOC CONCENTRATIONS (ppmv)																											
QUERY SEARCH START DATE: 01/01/95																											
QUERY SEARCH END DATE: 11/01/95																											
SEARCH PARAMETERS: LOCATION ALL BY ANALYSIS ALL																											
Sample ID	Sample Location	Analysis Method	Lowest MW	FC12	CLME	VC	FC11	DCE11	FC113	M1NCL	DCE12	DCA11	DCE1C	TC1ME	TC1A11	CTCL	DCA12	BZ	ICE	BZME	PCE	CLBZ	EBZ	KYLP	KYLO	Methane	TVH
2072905	VPI-504-03	8021	1.5				310	4.5	2.1	14	140	13						210	1.0			00	20		25000	NC	
2072906	VPI-504-03	8021	1.5				200											65							240000	24000	NC
2072907	VPI-504-03	8021	0.5				200	0.0	2.0	11	110	13						170	3.0			30	20		18000	NC	
2072908	VPI-504-03	8021	7.4				220			10								110	1.0						442	NC	
2072909	VPI-504-03	8021	1.1				220	2.2	0.52									100							200000	27200	NC
2072910	VPI-504-03	8021	0.75				10											17	2.4			0.7			91000	NC	
2072911	VPI-504-03	8021	0.47				10											15	1.0			0.70			10000	NC	
2072912	VPI-504-03	8021	0.025				12	0.52	2.1	0.34	0.21	0.007						21	1.3	1.0	0.037				70000	10000	NC
2072913	VPI-504-03	8021	0.4				13											0.008	0.32	0.70	0.24	0.0030			13000	NC	
2072914	VPI-504-03	8021	0.003				0.15	0.02	0.014	0.013								0.007	0.00	0.2	0.005				37000	3787.00	NC
2072915	VPI-504-03	8021	0.003				2	0.02										0.05	0.75			0.10	0.14	0.11	30000	3787.00	NC
2072916	VPI-504-03	8021	0.53				0.24	0.4	0.52	0.027	0.005							0.070	0.5	0.52	0.034				14000	NC	
2072917	VPI-504-03	8021	0.0054				0.01											50	4.7	0.47					230000	NC	
2072918	VPI-504-03	8021	0.15				22											30							400000	40100	NC
2072919	VPI-504-03	8021	1.1				0.00											10	1.1	0.10	0.072				120000	NC	
2072920	VPI-504-03	8021	0.038				140	0.005	0.003	0.27								100	12	0.06		02	40		100000	NC	
2072921	VPI-504-03	8021	0.15				64											270	0.5						15000	33236	NC
2072922	VPI-504-03	8021	1.1				24											37	3.2	0.06		37	30		37000	NC	
2072923	VPI-504-03	8021	0.03				15	0.00										15							87000	501201	NC
2072924	VPI-504-03	8021	0.075				10											0.5	2.0	2.2	0.05	0.000	41	22	3.1	400000	NC
2072925	VPI-504-03	8021	0.047				0.04											1.3			0.25				400	NC	
2072926	VPI-504-03	8021	0.011				0.01	0.005										1.3	0.2						3000	300.45	NC
2072927	VPI-504-03	8021	0.004				0.02											0.05	0.3						100	NC	
2072928	VPI-504-03	8021	0.037				0.07											37	2.7	0.2					130000	NC	
2072929	VPI-504-03	8021	0.075				44	0.07										50	14						80000	12420	NC
2072930	VPI-504-03	8021	0.075				74											77	0.1	0.5	0.24		40	10	2.2	94000	NC
2072931	VPI-504-03	8021	0.03				30	0.01										2.0	2.0	2.2	0.11		12	5.4	0.04	40000	NC
2072932	VPI-504-03	8021	0.27				0.2	0.20	2.0	2.1	0.22							10							10000	2033	NC
2072933	VPI-504-03	8021	0.03				33											64	1.2	0.31	0.043	0.20			80000	NC	
2072934	VPI-504-03	8021	0.02				0.26	0.040	0.040	0.04								0.72	2.2	2.0	0.04		10	0.0	0.0	45000	NC
2072935	VPI-504-03	8021	0.03				10	0.2	0.001									0.05	1.0	1.2					27000	3047.01	NC
2072936	VPI-504-03	8021	0.06				10	1.4										0.03	1.0	1.0	0.00		12	5.4	2.2	20000	NC
2072937	VPI-504-03	8021	0.033				0.4	0.007										0.37	3.5	3.7	0.00		30	13	1.3	270000	NC
2072938	VPI-504-03	8021	0.17				13	0.1	0.003									100							12000	NC	
2072939	VPI-504-03	8021	0.00				52											100							12000	2750	NC
2072940	VPI-504-03	8021	7.5				51											100							400000	NC	
2072941	VPI-504-03	8021	0.03				100											100	0.1	1.0		00	10	20	4	60000	NC
2072942	VPI-504-03	8021	0.33				200	0.5	7.2	4.2	0.7	0.5						530	130	0.1					23000	2750	NC
2072943	VPI-504-03	8021	0.75				100	4.0	3.0	0.3	0.4							200	0.5						60000	NC	
2072944	VPI-504-03	8021	0.03				110											230							23000	NC	
2072945	VPI-504-03	8021	0.03				47											100	10000	40	3.1				14000	33000	NC
2072946	VPI-504-03	8021	0.03				400											100							14000	NC	
2072947	VPI-504-03	8021	0.03				210											100							14000	NC	
2072948	VPI-504-03	8021	0.15				20											100							14000	NC	
2072949	VPI-504-03	8021	0.03				24											100							14000	NC	
2072950	VPI-504-03	8021	0.03				24											100							14000	NC	
2072951	VPI-504-03	8021	0.03				24											100							14000	NC	
2072952	VPI-504-03	8021	0.03				24											100							14000	NC	
2072953	VPI-504-03	8021	0.03				24											100							14000	NC	
2072954	VPI-504-03	8021	0.03				24											100							14000	NC	
2072955	VPI-504-03	8021	0.03				24											100							14000	NC	
2072956	VPI-504-03	8021	0.03				24											100							14000	NC	
2072957	VPI-504-03	8021	0.03				24											100							14000	NC	
2072958	VPI-504-03	8021	0.03				24											100							14000	NC	
2072959	VPI-504-03	8021	0.03				24											100							14000	NC	
2072960	VPI-504-03	8021	0.03				24											100							14000	NC	
2072961	VPI-504-03	8021	0.03				24											100							14000	NC	
2072962	VPI-504-03	8021	0.03				24											100							14000	NC	
2072963	VPI-504-03	8021	0.03				24											100									

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**APPENDIX B**  
**SITE-SPECIFIC HEALTH AND SAFETY PLAN**

## **HEALTH AND SAFETY PLAN**

### **1.0 PROJECT DESCRIPTION**

#### **1.1 Introduction**

The health and safety plan (HASP) defines the health & safety (H&S) requirements for Harding Lawson Associates (HLA) and subcontractor personnel working at the McClellan Air Force Base (McClellan AFB) fluidized bed adsorption system (FBAS) treatability study. The treatability study is to be run concurrently with the soil vapor extraction (SVE) catalytic oxidation (CatOx) system at the operable unit (OU) A, investigation cluster (IC) 31 worksite. The HASP provides a description of the proposed project, identifies the hazards potentially present at the worksite and the protective measures and controls that will be implemented to prevent or limit exposure to these hazards. The HASP will also define the personnel monitoring protocols that will be employed at the worksite, and identify key personnel H&S responsibilities, training and medical requirements, site control measures, and emergency response procedures.

This HASP is intended to address H&S issues specific to the tasks and activities associated with the operation of the FBAS during the three-month treatability test. However, since the test will be conducted concurrent with ongoing operations of the SVE CatOx system at IC 31, the hazards associated with the CatOx system may also be encountered by personnel working on the FBAS. Consequently, the HASP also identifies H&S issues and control measures related to the CatOx SVE at IC 31.

The HASP was prepared in accordance with the H&S standards, provisions, and requirements specified in the following regulations and guidance documents:

- Occupational Safety and Health Administration (OSHA) Standards for Hazardous Waste Operations and Emergency Response. Title 29 Code of Federal Regulations Part 1910.120 (29 CFR 1910.120).
- California Department of Industrial Relations, Division of Industrial Safety (Cal/OSHA), General Industry Safety Orders, Hazardous Waste Operations and Emergency Response. Title 8 California Code of Regulations Section 5192 (8 CCR 5192).
- Federal OSHA Occupational Safety & Health Standards. 29 CFR Parts 1910 and 1926.
- McClellan Air Force Base, Spill Prevention, Control, and Countermeasures Plan (SPlan 19-2). Volume 1: Emergency Response Action Plan, SPlan 19-2, and Appendices A, B, C, D, F and G.
- Army Corps of Engineers' Safety and Health Requirements Manual (EM 385-1-1, October 1992). OSHA Air Contaminants: Permissible Exposure Limits (PELs). 29 CFR 1910.1000. Cal/OSHA Standards Board PELs for Chemical Contaminants. 8 CCR 5155.
- Harding Lawson Associates Safety and Health Policy & Procedures Manual - Injury Illness Prevention Program.

## **GENERAL INFORMATION**

**Client:** McClellan Air Force Base (McClellan AFB)

**Project No.:** 37478 14

**HLA Site Manager:** Michael Sides

**Site Name:** McClellan Air Force Base IC 31, FBAS Treatability Test

**Site Location:** Southeast area of McClellan AFB

**Type of Facility:** FBAS demonstration system designed to treat a 90 to 110 standard cubic feet per minute (scfm) influent gas stream split from the IC 31 CatOx SVE system. The FBAS-treated effluent will be discharged to the CatOx SVE system influent to remove or neutralize residual VOCs or other contaminants generated as by-products of the FBAS process.

The CatOx SVE system at IC 31, includes one (1) vapor extraction well; air stripper effluent air, collection system (piping, valves, manifold); vacuum system (air/water separator, blowers, electrical switchgear, controls and safety valves); emissions control system, including a catalytic oxidizer for volatile organic compounds (VOCs) (blower, preheated chamber, catalytic combustion chamber), and caustic scrubber system for hydrochloric acid (HCl) and hydrofluoric acid (HF) vapors, dioxins (if present), and particulates (venturi unit, packed tower, particulate and dioxin removal system); and utilities (electricity, natural gas, water, etc.) including a 440-volt (V) power system.

**Status of Facility:** Active

**Scheduled Dates of Treatability Study:** Summer 1997

**Background Review:** Complete

**Hazard Overview:** Low to moderate

**Chemical Hazard Types/Characteristics:** Gas, vapors, liquids (halogenated solvents), toxic, volatiles.

**Purpose of Field Activities:** Conduct treatability test on a split stream from the IC 31 SVE system to test the effectiveness of the FBAS (i.e., destruction and removal efficiencies (DRE) of soil gas VOCs) under optimal and various other conditions (high and low inlet concentrations), identify/quantify by-products (e.g., NOx, HCl, etc.), quantify operating costs, and identify wastes recycling-related issues. HLA will be responsible for design of the tie-in of the FBAS with the existing SVE CatOx extraction/collection and CatOx systems, and appurtenant facilities (e.g., piping, blower, heat exchanger); construction and installation oversight; 1 to 2-week optimization period (startup, determine optimum operating parameters for high and low inlet concentration phase); 6- and 3-week demonstration operation and maintenance for the high and low concentration phases, respectively; and sampling/monitoring activities throughout the test including: FBAS influent and effluent vapors for the presence of halogenated VOCs, temperature, pressures, gas flow rates, and effluent for NOx and corrosive off-gasses.

### **1.3 Site History And Characteristics**

McClellan AFB is located approximately seven miles northeast of downtown Sacramento, California. Site IC 31 is a rectangular area located in the southeastern portion of McClellan AFB comprising 6.7 acres. IC 31 is currently the location, of Buildings 350 and 351 paved parking areas.

The SVE system was installed to remove VOCs from the vadose zone soil. This CatOx emission control was installed and is being operated by URS Consultants, Inc. (URS). Operation of the CatOx began on September 3, 1996. The VOCs present in the highest concentrations include trichloroethene (TCE) and other halogenated solvents, and petroleum hydrocarbons.

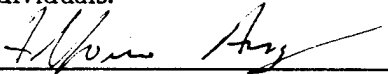
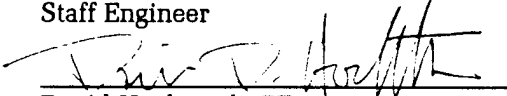
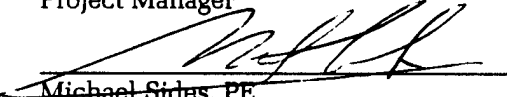

Based on the most recent (December 1996) onsite IC 31 SVE system analytical data, the VOCs detected most frequently in soil gas samples collected from the IC 31 extraction well include:

- Trichloroethene (TCE), maximum concentration of 70 parts per million by volume (ppmv).
- cis-1,2-Dichloroethene (cis-1,2-DCE), maximum concentration of 5.4 ppmv.
- 1,1-Dichloroethene, maximum concentration of 13 ppmv.
- 1,1,1-Trichloroethane (1,1,1 -TCA) maximum concentration of 5.5 ppmv
- Carbon Tetrachloride (CTCL) maximum concentration of 3.1 ppmv.

Other contaminants that have been detected in at least one sample, include Freon 113 (16 ppmv), chloroform (5.3 ppmv), benzene (9.3 ppmv), toluene (9.1 ppmv), tetrachloroethene (1.6 ppmv), ethylbenzene (68 ppmv), and total xylenes (62 ppmv).

#### 1.4 Approval of the HASP

This HASP document must be approved by various HLA health and safety and project personnel prior to implementation in the field. Approval is indicated by the signing and dating of the form which follows by the designated individuals.

Plan Prepared:	 Alfonso Ang Staff Engineer	<u>6/30/97</u> Date
Plan Approved:	 David Hochmuth, PE. Project Manager	<u>6/30/97</u> Date
	 Michael Sides, PE Task Manager	<u>6/30/97</u> Date
	 Chris Corpuz, CIH Program Safety and Health Officer (PSHO)	<u>6/30/97</u> Date

ALL PERSONNEL PARTICIPATING IN THE FIELD MUST BE TRAINED IN THE GENERAL AND SPECIFIC HAZARDS UNIQUE TO THE JOB AND, IF APPLICABLE, MEET RECOMMENDED MEDICAL EXAMINATION REQUIREMENTS. ALL SITE PERSONNEL AND VISITOR SHALL FOLLOW THE GUIDELINES, RULES, AND PROCEDURES CONTAINED IN THIS HEALTH AND SAFETY PLAN. THE PROJECT MANAGER OR SITE SAFETY AND HEALTH OFFICER MAY IMPOSE ANY ADDITIONAL PROCEDURES OR PROHIBITIONS THAT THEY BELIEVE ARE NECESSARY TO MAINTAIN SAFE OPERATIONS.

THIS PLAN IS PREPARED TO INFORM ALL FIELD PERSONNEL, INCLUDING HLA CONTRACTORS AND HLA SUBCONTRACTORS, OF THE GENERAL HAZARDS ASSOCIATED WITH REMEDIAL AND CONSTRUCTION ACTIVITIES. HOWEVER, EACH CONTRACTOR OR SUBCONTRACTOR MUST ASSUME DIRECT RESPONSIBILITY FOR HIS EMPLOYEES HEALTH AND SAFETY.

Site Safety and  
Health Officer (SSHO) \_\_\_\_\_  
(assigned on a task-by-task basis)

\_\_\_\_\_ Date



## **2.0 SAFETY AND HEALTH PROGRAM ORGANIZATION AND RESPONSIBILITY**

### **2.1 Organization**

All HLA work assignments are performed under the direction of an HLA project manager. The project manager receives technical support on safety and health issues from HLA's Industrial Hygiene and Regulatory Compliance Group and from other groups within HLA for other technical issues.

To assure safety and health regulatory compliance while maintaining a safe and healthful working environment, HLA's Industrial Hygiene and Regulatory Compliance Group will provide guidance to HLA's project managers through the assignment of field and administrative personnel. The following is the HLA Project Management team and the Industrial Hygiene and Regulatory Compliance team for the FBAS treatability study:

Project Manager	David Hochmuth
Task Manager	Michael Sides
Program Safety and Health Manager (PSHM)	Chris Corpuz
Project Safety and Health Officer (PSHO)	Gary Royer
Site Safety and Health Officer (SSHO)	(Assigned on a task-by-task basis.)

### **2.2 Responsibility and Authority**

All personnel are responsible for performing their function in a safe and healthful manner, preventing unnecessary risk of hazardous exposure to the personnel themselves, other site personnel, the public, or the environment. Each individual is responsible for acknowledging and following applicable safe work rules and guidelines outlined in the HASP and for using best professional judgment in minimizing the potential for injury or adverse health associated with all activities governed by this HASP.

### **2.3 Subcontractors**

HLA will perform the tasks outlined in the scope of work using a number of subcontractors yet to be determined. All HLA affiliates and subcontractors operate as independent entities and are expected to comply with federal, state, and local occupational safety and health regulations that apply to their work and employees. Subcontractors will be provide information about the site's hazards before working on the site.

Subcontractors must comply with the guidelines, rules, and procedures detailed in this HASP. Subcontract employees must be trained and informed of the safety and health requirements herein and must sign an acknowledgment that they have reviewed, understand, and will conduct their activities in full compliance with the HASP. Subcontractors will report to the Site Supervisor or other HLA personnel as directed.

### **3.0 SITE TRAINING AND CLEARANCE REQUIREMENTS**

All employees working onsite near contaminated soils who may be exposed to hazardous substances, health hazards, or safety hazards, and their supervisors and management responsible for the site shall receive training meeting the requirements of this section before they are permitted to engage in hazardous waste operation that could expose them to hazardous substances, safety, or health hazards. They shall also receive annual refresher training as specified in this section.

Employees shall not be permitted to participate in or supervise field activities until they have been trained to a level required by their job function and responsibility.

#### **3.1 Hazardous Waste Site Training**

Specific training requirements for personnel, including subcontractors conducting field activities, are divided into the following training categories:

- Regular Site Personnel Exposed to Hazardous Substances (such as system operators, sampling technicians, and supervisor personnel)
- Occasional Site Personnel Potentially Exposed to Hazardous Substances Below Permissible Exposure Limits (such as construction workers)
- Onsite management and supervisors.

These categories are discussed below.

##### **3.1.1 Regular Site Personnel Exposed to Hazardous Substances**

Site personnel whose job responsibilities cause them to be exposed to or to have the potential to be exposed to hazardous substances or health hazards are required to comply with Title 8, California Code of Regulations (CCR) Section 5192(e)(3)(A) (8 CCR Section 5192(e)(3)(A)). This regulation requires site personnel exposed to hazardous substances to complete 40 hours of offsite instruction and three days of field experience supervised by a trained supervisor.

The field activities for this scope of work requires all site workers to be 40-hour HAZWOPER trained.

##### **3.1.2 Occasional Site Personnel Potentially Exposed to Hazardous Substances Below Permissible Exposure Limits**

Occasional site personnel who visit the site for a specific limited task and whose exposure is designated by the Site Safety Officer to be under PELs are required to comply with 8 CCR Section 5192(e)(3)(B) or applicable state regulations. This regulation requires that these personnel receive a minimum of 24 hours of offsite instruction and one day of field experience supervised by a trained supervisor.

In accordance with 8 CCR Section 5192(e)(3)(B), regular (as defined in Section 4.1.1 above) and occasional site personnel having completed an initial 24-hour classroom instruction must complete an additional 16 hours of offsite instruction and two days of field experience supervised by a trained supervisor before they are qualified to engage in activities that may expose them to hazardous substances above PELs.

### **3.1.3 Management and Supervisory Training**

In accordance with 8 CCR Section 5192(e)(4), individuals who manage or supervise personnel engaged in hazardous waste operations at the site must receive 40 hours of offsite instruction and three days of field experience supervised by a trained supervisor. In addition, management and supervisory personnel shall receive an additional 8 hours of specialized training that addresses the safety and health program, training requirements, personal protective and respiratory equipment program, health hazard monitoring procedures, accident investigation, and emergency response procedures.

### **3.1.4 Hazardous Waste Site Training Elements**

The hazardous waste site training shall thoroughly cover the following:

- Names of personnel and alternates responsible for site health and safety.
- Engineering control and work practices by which the employee can minimize risks for hazards.
- Medical surveillance requirements, including recognition of symptoms and signs which might indicate overexposure to hazards.
- The biological, chemical, radiological and physical hazards present on the site and their respective properties.
- The potential routes exposure to chemicals, the possible toxic effects, the IDLH and Permissible Exposure Limit values of chemical hazards, and the level of personal exposure which can be anticipated, acute and chronic effects of toxic chemicals.
- Heat and/or cold stress prevention, treatment, and monitoring.
- Personal cleanliness and restrictions on eating, drinking, and smoking on the job.
- The availability of onsite potable water and toilet facilities.
- Applicable provisions of the OSHA standards and the Injury and Illness Prevention Program.
- Permit-required confined space entry procedures.
- Spill containment program.
- The functions, capabilities, limitations, use, and maintenance of monitoring equipment.
- The use, care, and disposal of the specific PPE selected for this work. The PPE shall be available for Hands-on familiarity and practice donning, as needed.
- Handling of medical emergencies including the locations of telephones and numbers for ambulance service, and hospital locations.
- The emergency contingency procedures.
- The fire and accident response procedures.
- Basic operational safety, emphasizing the hazards expected on the site employee rights and responsibilities under OSHA.
- Site-specific, task-specific activity hazard analysis.

### **3.2 Refresher Training**

Annual refresher training in accordance with 8 CCR Section 5192(e)(8) shall be completed at least annually following the completion of the individual's 40-hour or 24-hour training course. Personnel will be required to attend the annual refresher training to maintain their qualifications for hazardous waste operation.

### **3.3 Site- and Task-Specific Training**

Required site- and/or task-specific training may also include:

- CPR/First Aid training (all attempts shall be made to provide a CPR/First Aid trained individual during all intrusive and construction related activities)
- Bloodborne pathogens training (for the CPR/First Aid providers above)
- Confined-space entry procedures (if applicable).

Any additional, task-specific training covering site hazards, procedures, and all contents of this HASP will be conducted by the SSHO or the designee for all onsite employees, including those assigned only to the Support Zone, as well as onsite visitors or regulatory agency representatives, before work begins and on an ongoing basis.

### **3.4 Subcontractor Training**

All subcontractors must certify and provide proof that their employees working onsite have been trained in accordance with the requirements of this HASP and with all applicable regulations. The SSHO shall be provided and will maintain subcontractor employee documentation, including training and medical clearance documents. However, subcontractors are responsible for providing the required health and safety training and medical monitoring to their own employees.

### **3.5 Documentation**

Copies of all training records shall be maintained onsite by the SSHO and appended to this HASP. The SSHO or designee is also responsible for verifying that site employees and subcontractors maintain annual refresher, other applicable training, and site clearances before they are permitted onsite. All site employees and subcontractors are required to maintain copies of their training record onsite.

#### **3.5.1 Visitor Orientation Training**

All visitors to the site are required to review the HASP and relevant sections of the workplan and sign an acknowledgment that they have read and understand these documents and will follow safe work practices while onsite. Visitors must also meet the site-specific PPE, medical surveillance, and training requirements prior to entrance into any controlled site zone (including the Support Zone) and will receive site indoctrination training from the SSHO.

#### **3.5.2 Tailgate and Kickoff Safety Meetings**

Tailgate safety meetings will be held daily prior to beginning work activities. Kickoff safety meetings will be held at the start of a job and whenever a new task, procedure, piece of equipment, level of PPE, or hazard is introduced, changed, or discovered. A Site-Specific Health and Safety Worksheet (Attachment 1) will be completed by the SSHO detailing field activities and required PPE prior to beginning work. Attendance at all meetings shall be documented on the Site-Specific Health and Safety Worksheet provide and the Daily Health and Safety Checklist in Attachment 2.

## **4.0 MEDICAL SURVEILLANCE PROGRAM**

All field personnel must have the appropriate medical clearances. It is the responsibility of the PSHO and the SSHO to ascertain that all HLA personnel onsite are in compliance with HLA's medical surveillance program and OSHA's medical and respiratory protection standards. The SSHO will also ascertain that all subcontractor personnel and visitors to the site have the appropriate clearances prior to being allowed access to the site.

Certification of site personnel's participation in a medical surveillance program shall be documented by the SSHO and appended to this HASP or the Personnel Field Clearance Verification Log (Attachment 5).

The medical surveillance program shall be instituted for the following HLA employees:

- Any employee who is or may be exposed to hazardous substances or health hazards at or above the Permissible Exposure Limits or, if there is no Permissible Exposure Limit above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year
- Any employee who wears a respirator during an part of a day for a period of 30 days or more in a year, or as required by 8 CCR 5144
- Employees exhibiting symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation.

### **4.1 Frequency of Medical Examinations and Consultations**

Medical examinations and consultations are made available to HLA employees covered under Section 5.0 on the following schedules:

- At least once every twelve months unless the attending physician believes a longer interval (not greater than biennially) is appropriate
- At termination of employment or reassignment to an area where the employee would not be covered if the employee has not had an examination within the last six months
- As soon as possible, upon notification by an employee either that the employee has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards or that the employee has been injured or exposed above the Permissible Exposure Limits or published exposure levels in an emergency situation
- At more frequent times, if the examining physician determines that an increased frequency of examination is medically necessary.

For employees who may have been injured, received a health impairment, developed signs or symptoms which may have resulted from exposure to hazardous substances resulting from an emergency incident, or who have been exposed during an emergency incident to hazardous substances at concentrations above the Permissible Exposure Limits or the published exposure levels without the necessary personal protective equipment being used shall undergo a medical examination:

- As soon as possible following the emergency incident or development of signs or symptoms

- At additional times, if the examining physician determines that follow-up examinations or consultations are medically necessary.

#### **4.2 Examination by a Physician and Costs**

All medical examinations and procedures shall be performed by or under the supervision of a licensed physician certified in occupational medicine by the American Board of Preventive Medicine, and shall be provided without cost to the employee, without loss of pay, and at a reasonable time and place.

#### **4.3 Information Provided to the Physician**

The employer shall provide one copy of this standard and its appendices to the attending physician, and in addition, the following for each employee:

- A description of each employee's duties as they relate to the employee's exposures
- Each employee's exposure levels or anticipated exposure levels
- A description of any PPE used or to be used by each employee
- Information from previous medical examinations of each employee which is not readily available to the examining physician
- Information required by 8 CCR 5144 for each employee.

#### **4.4 Physician's Written Opinion**

The written opinion obtained by the employer shall not reveal specific findings or diagnoses unrelated to occupational exposures. The physician shall provide the results of the medical examination and tests to the employee if requested. The employer shall obtain and furnish the employee with a copy of a written opinion from the examining physician containing the following:

- The physician's opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health from work in hazardous waste operations or emergency response, or from respirator use
- The physician's recommended limitation upon the employee's assigned work
- A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.

#### **4.5 Medical Surveillance Recordkeeping**

An accurate record of the medical surveillance shall be retained. This record shall be retained for the period specified and meet the criteria of 8 CCR 3204. The record shall include at least the following information:

- The name and social security number of the employee
- Physician's written opinions, recommended limitations, and results of examinations and tests
- Any employee medical complaints related to exposure to hazardous substances
- A copy of the information provided to the examining physician by the employer, with the exception of the standard and its appendices.

## 5.0 HAZARD ASSESSMENT

The H&S hazards that may be encountered by personnel during the course of FBAS installation, treatability test O&M, and sampling/monitoring activities are addressed in this section.

### 5.1 Chemical Hazards

Task-by-Task Hazard Analysis . Personnel could be exposed to potential chemical hazards during FBAS test operation, and monitoring/sampling activities at IC 31 as a result of: 1) leaks in the SVE CatOx treatment system or FBAS, 2) exposure to hazardous substances stored or used at the worksite, or 3) leaks/releases at the influent and effluent sampling ports during monitoring/sampling activities.

1. Leaks or uncontrolled releases of vapors or gases from the SVE CatOx treatment system are not expected from the portions of the system operated under a vacuum. In addition, the system is designed to automatically shut down in the event of a release from the portion of the system under positive pressure. The SVE system draws soil gas VOCs from the vapor extraction well and air strippers into the collection system piping, manifold connection point, and into the air/water separator (AWS). The AWS removes entrained liquids (condensate) and particulate matter from the saturated soil gas prior to entering the SVE CatOx treatment system. The VOC levels and potential exposure at the worksite are monitored by the SSHO assigned to the SVE CatOx system at IC 31 throughout field activities.

A slipstream from the SVE CatOx treatment system will be used during the FBAS treatability study. Due to the nature of the FBAS, the system is operated under positive pressure to allow fluidization of the resin beds. However, no leaks or uncontrolled releases of vapors or gases from the FBAS are expected since the system is designed specifically to work under positive pressure. All piping installed for the connection of the FBAS and related equipment will be pressure tested prior to the beginning of the treatability test to ensure they are leak free. During weekly site visits, PID readings will be collected along the FBAS process piping to check for developing fugitive emissions. In the event a leak is detected, the FBAS will be manually shutdown and appropriate repairs to the piping will be conducted. In addition, electrical interlock will allow for the shutdown of the FBAS in the event the CatOx treatment suffers an automatic shutdown in the event of a release.

2. The only hazardous substance to be used at the IC 31 worksite is the SVE CatOx system caustic scrubber solution (25% sodium hydroxide), no hazardous materials are required or used during operation of the FBAS. FBAS test personnel will not be responsible for operation and maintenance (O&M) of the SVE CatOx system, including the caustic scrubber and solution. Other than an accidental release, there is little likelihood of an exposure to the caustic solution or caustic vapors. However, potential chemical hazards associated with the caustic solution are discussed further below.
3. Releases of gases/vapors from the FBAS influent and effluent sampling ports could result once the sampling ports are opened if there is a leak or opening in the sampling line. Samples will be collected using the following sampling methods/apparatus: Tedlar<sup>®</sup> bags and SUMMA<sup>®</sup> steel canisters for VOCs, and NMOCs.

The sampling apparatus will be connected to the sampling ports prior to opening the valves, and disconnected only after the valves are closed. Although a release is possible, the extent and duration of any exposure would be extremely limited. Contaminant concentrations in open well-ventilated areas of the IC 31 worksite, particularly in the breathing space of field

personnel, are not expected to exceed PELs discussed below. Nevertheless, the SSHO will monitor the breathing space of personnel sampling/monitoring the influent and effluent for the presence of total VOCs with a PID. Personnel will be required to implement necessary controls and/or don appropriate additional PPE based on the results of the monitoring.

4. Releases of gases/vapors and liquid solvent from the condensate drum could result during collection of the condensate sample. Condensate samples will be collected using the following sampling method/apparatus: Disposable Polyethylene Coliwesas and laboratory supplied vials.

The polyethylene coliwasa will be inserted into the condensate drum through a 2-inch bung opening on top of the drum. Once the desired depth in the drum is reached, a liquid phase sample will be collected into the coliwasa and extracted from the drum. Although a release of gases/vapors and a solvent spill is possible, the extent and duration of any exposure would be extremely limited and the amount of solvent spill would be limited to the sample collected with the coliwasa (1,100 ml capacity). Contaminant concentration in open, well-ventilated areas of the IC 31 worksite are not expected to exceed PELs discussed below. Personnel conducting the sampling will be required to implement necessary controls and/or don appropriate additional PPE based on result of the monitoring of the breathing space.

Soil Gas VOCs and Treatment System By-Products. Chemicals that may be present at the site are listed in Table 1, and include soil gas constituents (i.e., VOCs), chemicals potentially generated (i.e., treatment system by-products) by the FBAS and existing CatOx SVE treatment systems, and chemicals that are used or stored at the IC 31 worksite. The table provides general health hazard information and acute exposure symptoms.

Table 1 also lists federal OSHA and Cal/OSHA enforceable worker airborne exposure standards, or PELs, and concentrations immediately dangerous to life or health (IDLH). Exposure to any of these chemicals in excess of the enforceable PELs without appropriate respiratory protection is expressly prohibited.

Dioxin (2,3,7,8-tetrachlorodibenzo-p-dioxin), dioxin congeners, and dibenzofurans are formed when halogenated VOC (HVOC) mixtures are exposed to high temperatures during CatOx treatment. The IC 31 SVE CatOx system effluent gas, scrubber stack offgas and blowdown, AWS water and sediments, and scrubber caustic solution, are sampled and analyzed for the presence of dioxins/dibenzofurans. Dioxins/dibenzofurans are not formed during FBAS treatment due to the substantially lower temperatures at which the system is run. The SVE CatOx system SSHO monitors the results of the sampling to determine the presence of dioxins and possible exposure of IC 31 field personnel. If the data indicate the presence of dioxins/dibenzofurans in the SVE CatOx system offgas, or possible worker exposure to airborne particulates or vapors, additional control measures will be implemented.

CatOx of HVOCs also produces HCl vapor which is neutralized by the sodium hydroxide (25 percent NaOH) scrubber solution converting it to nonhazardous sodium salt (NaCl). Since the system may not remove all of the vapors, and low levels could be released from the 30-foot scrubber stack, the presence of HCl vapor at the worksite will be monitored throughout the FBAS treatability test. Personnel assigned to the SVE CatOx system at IC 31 monitor the worksite for soil gas VOCs and CatOx system by-products (HCl) in accordance with the monitoring provisions specified in previous work plans for the SVE CatOx system prepared by URS. If monitoring data indicate the presence of HCl vapor at the worksite or possible worker exposure to levels approaching or exceeding PELs, appropriate controls will be implemented or the level of protection upgraded.



Hazardous Materials Used On-Site. The caustic scrubber solution, discussed above, is stored on-site in a 7,000-gallon double-contained above-ground storage tank. Personnel at IC 31 will be made aware of the potential hazards associated with any dermal/eye or respiratory contact with the caustic solution and vapors. Personnel who may come into contact with the solution, will be provided with appropriate chemical-resistant clothing (e.g., rubber or neoprene safety boots, Saranex<sup>®</sup>-coated Tyvek<sup>®</sup> coveralls, rubber apron, nitrile or Viton<sup>®</sup> gloves, face shield) and, if deemed necessary by the SSHO, a full-face respirator with organic vapor/acid gas cartridges and dust/mist prefilter.

Material Safety Data Sheets (MSDSs) will be maintained at the worksite or field vehicle for any hazardous materials used during the FBAS treatment test or otherwise present at IC 31. These materials include chemicals such as the 25 percent NaOH solution discussed above, and any decontamination solutions (methanol, hexane, HCl) that may be needed to clean reusable sampling equipment to avoid cross-contamination. The MSDSs will be available to all personnel in accordance with 29 CFR §1920.1200 (Hazard Communication), and the SSHO will advise personnel of potential hazards associated with these chemicals, appropriate storage and safety precautions, and spill response procedures. Copies of all MSDSs must be forwarded to 652 Medical Group, 3200 Peacekeeper Way #5, McClellan AFB, before any hazardous materials are brought on base.

## **5.2 Physical Hazards**

### **5.2.1 Heat Stress**

The SSHO shall be responsible for evaluating conditions at each task-specific operation and for making the determination to monitor for (or not monitor for) worker heat stress. Wet bulb globe temperature (WBGT) and/or physiological monitoring may be implemented by the SSHO and used to establish work/rest regimes or to modify existing work/rest regimes. Documentation of such monitoring shall be maintained by the SSHO.

The SSHO shall determine the potential for heat stress based on worker fitness, worker acclimatization, planned activities, and environmental conditions. If the SSHO determines that the potential for heat stress exists, the following measures will take place:

- All site workers shall be informed of the potential for heat stress during the daily safety meeting.
- The SSHO shall determine whether any worker are at particular risk for heat stress.
- The SSHO shall assure that sufficient quantities of potable water and electrolyte drinks are available in the decontamination area and that a shaded rest area is available at or immediately outside the decontamination area.
- All worker shall drink 16 ounces of water before beginning work and at least 16 ounces during each rest period.

For operations at which workers are wearing chemical protective clothing, physiological monitoring will be implemented when the ambient temperature exceeds 78°F (25.5°C) or when the WBGT temperature exceeds 72°F.

### **5.2.2 Wet Bulb Globe Temperature Monitoring**

Field activities that have been determined by the SSHO to have the potential for worker heat stress shall be monitored with a WBGT heat stress monitor. This monitor shall be placed in the employees work area and will continuously monitor WBGT heat stress indices for the duration of the work shift. WBGT values will be documented on the Heat Stress Monitor Log (Attachment 3). The SSHO will use these values in combination with physiological monitoring results to make adjustments to employees work/rest cycles as necessary. Work/rest cycles will be established in accordance with American Conference of Governmental Industrial Hygienists guidelines (1995-1996) (*Threshold Limit Values [TLVs] for Chemical Substances and Physical Agents and Biological Exposure Indices [BEIs]*).

Note that increases to the work period are made based on the work-rest regime established from WBGT readings. These WBGT readings will change throughout the day as meteorological conditions change.

### **5.2.3 Physiological Monitoring**

After the initial work/rest regime is established by the SSHO, physiological monitoring will be conducted to determine if the established work/rest regime should be adjusted. The guidelines to adjust the regime are summarized as follows:

- A baseline heart rate and oral temperature for each worker will be determined prior to onsite activities.
1. Increasing work rate
    - If a worker's heart rate and oral temperature do not increase slightly (10 percent or less for the heart and 0.5 degrees or less for the oral temperature) from baseline readings after the first work cycle, the work period (according to the established work-rest regime) can be increased by 20 percent.
    - The worker shall be monitor closely after the next work cycle, and, if there are still no significant increases in heart rate and oral temperature, the work period can increase by an additional 10 percent and the rest period remain the same.
    - Increases in the work period can be made throughout the shift if there are no significant increases in the physiological monitoring indices.
    - Note that the increases to the work period are made based on the work-rest regime established from WBGT readings. These WBGT readings will change throughout the day as meteorological conditions change.
  2. Decrease work rate
    - If a worker's heart rate exceeds 110 beats per minute immediately after a work period, the next work cycle should be decreased by 30 percent without change in the rest period.
    - If a worker's heart rate still exceeds the 110 beats per minute after the next work period, the following work cycle will be decreased by another 30 percent.
    - The worker's work cycle will continue to decrease until the heart beat id below 110 beats per minute.
    - If the oral temperature exceeds 99.6°F (37.6°C), the next work cycle will be decreased by 30 percent without change to the rest period.
    - If the oral temperature still exceeds 99.6°F at the beginning of the next rest period, the following work cycle will be decreased by another 30 percent.
    - Workers will not be permitted to return to a work area when the oral temperature exceeds 100.6°F (38.1°C).

#### **5.2.4 Cold Stress**

The FBAS treatability test is not scheduled to extend into the winter rainy season. Consequently, cold stress is not expected for this project. However, to lessen or ease the effects of occasional inclement or cold weather, personnel will be provided with rain suits, and should wear adequately insulated/layered clothing and maintain a change of clothing onsite.

#### **5.2.5 Adverse Weather**

The SSHO, in consultation with the TM, will be responsible for determining if field activities can be continued in a safe manner. During periods of high winds, electrical storms, heavy rain, or visibility-impairing conditions, outdoor activities will be terminated and field personnel will remain inside the HLA field vehicle or other nearby shelter until conditions improve. Some outdoor activities may be permitted during inclement weather (rain, wind) but personnel must be alert to possible hazards, and to limit activities to safe areas at ground level.

#### **5.2.6 Noise Hazards**

Noise sources consist of the SVE CatOx system noise-generating equipment, and regular aircraft overflights which expose site personnel to brief (4 to 5 seconds) but elevated noise levels. The blowers, the primary SVE CatOx system noise source, are housed in an enclosed area to reduce noise levels. Nevertheless, noise levels immediately adjacent to this equipment may exceed 85 dBA which would constitute a noise hazard and also interfere with communication. The SVE CatOx system SSHO monitors worker noise exposure levels with a Type 2 sound level meter. Personnel exposed to noise levels exceeding 85 dBA will be required to wear ear plugs and/or ear muffs with noise reduction rating (normally 25 to 29 dB) sufficient to attenuate noise to acceptable exposure levels (i.e., 85 dBA). Hearing protection will be worn by site personnel until the SSHO determines it is no longer necessary.

#### **5.2.7 Hot Pipes/Hot Surfaces**

The extracted soil gas is preheated to approximately 750°F (400°C) prior to entering the SVE CatOx combustion chamber where it may reach temperatures of 1,200°F (650°C). The hot SVE CatOx gases are then routed to the caustic scrubber where they will be cooled to approximately 200°F (90°C). The FBAS system desorbed VOC gases are expected to reach temperatures of 200°F to 300°F. All pipes or other potentially exposed surfaces in the work area having an external temperature exceeding 140°F (60°C), or sufficiently hot to burn human tissue on momentary contact, will be covered with thermal insulation, or otherwise guarded to avoid incidental or accidental contact. All hot surfaces will be clearly marked or labeled with appropriate warning signs. The SSHO will advise all FBAS treatment test personnel of the location of all hot pipes/surfaces. If it is necessary to work near hot surfaces, the SSHO will provide thermal shielding or other feasible engineering controls, or heat-resistant gloves and other appropriate PPE.

#### **5.2.8 Explosive Atmospheres**

Explosive gases and/or atmosphere are not expected during site activities. However, if the SSHO determines that such monitoring is necessary, the following procedures will be used:

- A combination combustible gas indicator (CGI) oxygen level meter will be used as appropriate to monitor for the possible presence of explosive gases (e.g., methane) and atmospheres. Equipment will be calibrated daily before work begins and in accordance with manufactures instructions. If feasible, the calibration gas will be specific to the combustible gases suspected to be present.
- Continuous monitoring for combustible gases will be performed at the sampling point. If the monitoring instrument indicates greater than 10 percent of the lower explosive limit (LEL),

personnel must leave the area. Explosion-proof fans should be used to lower the LEL. Personnel will not be allowed to reenter the area until the LEL is less than 10 percent.

### **5.2.9           Slips, Trip, and Fall Hazards**

Personnel will be reminded daily to maintain sure footing on all surfaces. Use of safety harnesses will be required for any personnel working 6 or more feet above any surface, including manlifts. Use of hand rails when climbing stairs will be enforced, and handrails will remain secured until the support structure itself is removed and lowered to ground level.

Work surfaces of unknown or suspect integrity will be strengthened or overlain with a work platform capable of supporting all personnel and equipment in use in that area. Non-skid mats, pallets, or similar devices will be placed in extremely slippery or wet areas to reduce slip and fall hazards.

To minimize tripping hazards caused by construction debris, material will be removed daily from the work areas and stockpiled in appropriate designated storage areas. This "housekeeping" effort will be enforced by SSHO at the end of each day.

### **5.2.10          Skeleto-Musculature Injury Hazards**

FBAS treatment test operations and monitoring activities are not expected to require any heavy lifting. If necessary, the SSHO will ensure that appropriate material handling equipment (e.g., drum trucks, hand carts, drum cradles, dollies, etc.) are available at the worksite. Personnel are not to attempt to lift large, heavy, or cumbersome objects without assistance.

### **5.2.11          Tool and Equipment Hazards**

FBAS treatment personnel will be trained in proper handling and maintenance requirements for any tools and equipment to be used at the work site. Hand-held power tools should be held firmly. Electrical cords must be checked for broken insulation and potential exposure to water or other liquids. The use of ground fault circuit interrupters shall be required when using any AC-powered electrical tools. Safety glasses and, if necessary, hearing protection will be worn while operating powered tools or equipment.

### **5.2.12          Confined Spaces**

Entry into any confined space is strictly prohibited unless a Permit for Confined Space Entry is completed by the SSHO and approved by the PSHM in accordance with the provisions and training requirements of the HLA Health and Safety Policy and Procedures Manual for Permit Required Confined Space Entry as required by OSHA (29 CFR 1910.146) and McClellan AFB confined space requirements. A confined space for the purposes of this HASP includes: manholes, sewers, pipelines, storage tanks, process/reaction vessels, stacks, pits, basements, tunnels, and any spaces or enclosures that have limited ventilation or openings for entry or egress, or are not meant for human occupancy.

In the event a confined space entry is required, the following measures must take place:

- All personnel involved in the entry including the Authorized Entrant, Attendant, Entry Supervisor, and Rescue Service must be formally trained in Permit-Required Confined Space Entry Procedures. Obtain a permit for confined space entry from the SSHO.

- Monitor oxygen (O<sub>2</sub>), LEL, and organic vapors before entering a confine space. If the following values are exceeded, do not enter:
  - O<sub>2</sub> less than 19.5 percent or more than 23 percent
  - Total hydrocarbons greater than 5 parts per million (ppm) above background if all air contaminants are not identified
  - Concentrations of specific contaminants exceeding action levels as indicated in Table \_\_\_\_
  - Flammable gases more than 10 percent of LEL
- Monitor O<sub>2</sub>, LEL, and organic vapors continuously while inside a confine space. If Threshold Limit Values (TVLs) cited in Table 1, are exceeded, evacuate immediately. Record instrument readings.
- Ensure that at least one person capable of pulling personnel from the confine space is on standby outside the confine space. The observer must be trained in CPR and first aid.
- Use portable fans or blowers to introduce fresh air to confine spaces whenever respirator use is required.
- Do not perform work that involves the use of flame, arc, spark, or other source of ignition in a confine space.

### **5.2.13 Electrical Hazards**

The electrical supply to the IC 31 worksite is a 460 Volt (V), 3-phase, 3-wire radial supply system. Transformers are in place to provide low voltage (240V and 120V) systems as necessary for different pieces of equipment. A 120V single-phase supply provides power for the alarm dialer, control panels, and lighting. The power lines, cables and wires could pose a potential shock or electrocution hazard if workers contact or sever them during site operations. Electrical equipment could also provide an ignition source in the presence of an explosive or flammable environment. In addition, the unexpected start-up (energizing) or release of stored energy or material could cause injury to worksite personnel working on or near SVE CatOx treatment system or FBAS equipment or machinery.

All electrical systems (wiring and equipment) currently in use, and those to be installed for the FBAS, are to be listed by a nationally recognized testing laboratory as suitable for installation and use at the IC 31 worksite, and installed in accordance with applicable state and federal regulations (29 CFR §1910 Subpart S; 8 CCR Div. 1, Subchapter 5, Electrical Safety Orders), manufacturer's instructions, National Electrical Safety Code (NESC), and National Electrical Code (NEC). Low-voltage equipment with ground-fault interrupters and water-tight corrosion-resistant connecting cables are and will continue to be used. All electrical circuits are to be grounded in accordance with NEC and NESC standards.

Sufficient access and working space (no less than three feet) will be provided around all live parts of the electrical equipment. Live parts of electric equipment 50V or more will be guarded against accidental contact by limiting access or partitioning or screening. An emergency shut-off for all FBAS powered units will be located, clearly labeled, or marked. The SVE CatOx system emergency shut-off is located at the motor control center.

As discussed above, the SVE CatOx system is operated under vacuum to prevent releases to the atmosphere, in addition it is also designed to limit VOC soil gas levels within the system to less than 25 percent LEL. The only ignition source potentially in contact with elevated VOC levels, is the vacuum blower system. The motors selected for the SVE CatOx system meet requirements for a Class 1, Division 2 hazardous (classified) location.

The SSHO will determine if machinery or equipment pose a potential start-up hazard and should be locked out during FBAS O&M or sampling/monitoring activities. Lock-out will be conducted in accordance with the provisions of the SVE CatOx System O&M Manual. The SSHO assigned to the SVE CatOx system at IC 31, in coordination with the FBAS SSHO, will locate all isolating devices to be certain which switch(s), valve(s), or other devices may need to be locked-out, and lock-out all appropriate switches at the main control panel with a number-coded padlock.

## **6.0 PERSONAL PROTECTIVE EQUIPMENT AND CONTROLS**

The following discussion identifies the appropriate personal protective equipment (PPE), engineering and administrative control measures, and monitoring/sampling procedures to be employed at the IC 31 FBAS test work site to limit the risk of exposure to potential hazards.

### **6.1 Engineering/Administrative Control Measures**

Field personnel will be reminded during safety briefings to be aware of potential chemical and physical hazards and to immediately inform the SSHO, or other supervisory personnel of any unsafe conditions or new hazards they may encounter. The SVE CatOx system SSHO, in coordination with the FBAS SSHO, is responsible for ensuring that site control measures are implemented at IC 31 (e.g., marking, warning signs, placards, erecting barriers, securing and controlling access), hazardous materials are appropriately stored and secured, and informing field personnel of specific worksite hazards.

Worksite activities will be scheduled for daytime hours. If evening or nighttime work is required, lighting will be arranged so that any single lighting unit failure will not leave any area in total darkness. Activities within the IC 31 worksite will require a minimum intensity of 30 foot candles; areas outside the worksite may require substantially less illumination; exitways, walkways, ladders, stairs, etc. would require about 10 foot candles.

In addition, HLA has general health and safety work practices which should be followed to ensure a safe working environment for all project personnel (see Appendix). All field personnel, including subcontractors, must adhere to these safe work practices. Failure to do so will result in cessation of work until such time as the unsafe activity or work practice ceases or is corrected.

### **6.2 Personal Protective Equipment**

The level of PPE required at the worksite depends not only on the existing monitored conditions and hazards, but also on the specific tasks to be performed. As discussed above in Section 5.0, the only chemical exposure during the FBAS treatment test that could potentially occur would result from a leak or release from the influent and effluent sampling ports or sampling lines during monitoring/sampling activities. Exposure to the physical hazards identified in Section 4.0, will be controlled through implementation of administrative/engineering controls, when feasible, the use of safe work practices, site-specific training, and the use of PPE.

Level D-modified PPE will be worn as the initial basic work uniform. This level of PPE provides minimal protection against chemical hazards and will be worn at the worksite as long as there are no respiratory or significant dermal contact hazards. The Level D-modified PPE used will consist of:

- Hard hat, when working near heavy equipment, overhead or other hazards. The IC 31 worksite is considered a hard hat area by McClellan AFB. A face shield should be attached whenever there is a potential splash hazard from any hazardous or harmful substances.
- Steel-toed safety boots (rubber or neoprene whenever there is potential exposure to corrosives, contaminated water, or other liquids).
- Disposable chemical-resistant (e.g., butyl rubber, nitrile, Viton<sup>®</sup>, polyvinyl chloride [PVC]) gloves when handling corrosives or contaminated wastes (groundwater, spent carbon, sediment), heavy work gloves may be worn over the chemical-resistant gloves to provide additional abrasion resistance, but if contaminated they must be discarded. Surgical (vinyl, latex) gloves are not chemical protective but can be used to prevent sample contamination if there is no potential for dermal contact with hazardous substances.

- Safety glasses or goggles meeting ANSI standard Z87. 1. Not to be worn as protection when working with corrosive or other substances posing a splash hazard; a face shield and other appropriate PPE is required when a splash hazard exists.
- Ear plugs and/or ear muffs as necessary to reduce noise exposure to sound levels less than 85 decibels-averaged (dBA).
- Cellular telephone or other two-way communication system when no telephone hook-up has been installed at the worksite.

The level of protection provided by Level D-modified PPE will be upgraded to Level C based upon a change in site conditions or monitoring results which indicate the need for respiratory protection and the presence of toxic contaminants or changes in potential exposure pathways. Level C PPE, if respiratory and additional dermal protection is necessary, will be immediately available at the worksite. Level C, selected for the types and level of airborne contaminants that could reasonably be expected at the IC 31 worksite, would consist of all Level D PPE listed above, including a NIOSH/MSHA-approved full-face air-purifying respirator with organic vapor/acid gas cartridges and dust/mist prefilter; and Tyvek®, or chemical resistant coverall such as Saranex®-coated Tyvek® if airborne concentrations pose a potential skin hazard.

Conditions requiring Level A or B protection are not anticipated during the FBAS treatability test. If site conditions exist that require Level A or B protection, all work will cease and PPE requirements will be reevaluated by the SSHO. Table 2 identifies the appropriate action and PPE level required when monitoring indicates specified action levels are reached.

The SSHO will ensure that the required PPE (e.g., protective footwear, and head, eye, face, hearing, and respiratory protection) is tested, inspected, and maintained in serviceable and sanitary condition during treatment test activities. Any defective PPE will be discarded or returned to the manufacturer.



## **7.0 PERSONAL MONITORING/AIR SAMPLING**

A PID with a 10.2 eV lamp will be used to monitor air concentrations of known or suspected volatile organic gasses and vapors. (Monitoring will be conducted continuously during sampling or intrusive activities. Data obtained from the PID will be used to assess the need for, or adequacy of, respiratory protection; determine the appropriate level of PPE; provide rationale for the selection or modification of respiratory protection; document potential exposures; and evaluate potential health hazards. Monitoring will be conducted by the SSHO, in coordination with the SVE CatOx SSHO, throughout treatment test activities.

Measurements should be taken within the breathing zones of workers. If action levels are reached for a 1-minute reading, appropriate action must occur. At a minimum, all direct-reading instruments shall be calibrated daily. Action levels for gases and vapors are shown in Table 2. Additions or modifications to these monitoring requirements may be instituted based on the results of influent and effluent sampling or monitored conditions at the worksite.

If the PID monitoring indicate possible exposure levels exceeding PELs, and respiratory protection (i.e., Level C) is required, the SSHO will determine the need to collect air samples in the breathing zone of field personnel. Sampling will be conducted in accordance with NIOSH procedures and protocols or other methods deemed appropriate by the SSHO, and approved by the PSHM.

Sampling results will help to determine the efficiency of the FBAS, identify treatment system effluent constituents, and if the releases pose any hazards to the public or personnel at McClellan AFB or the worksite. The SSHO will review the results of sampling activities, notify field personnel, and, if necessary, modify the HASP to address the findings.

## **8.0 SITE CONTROL**

### **8.1 Worksite Access And Security**

Access to McClellan AFB is controlled at various entry gates. Visitors are required to check in at the entry gate guardhouse and present their license and car registration. FBAS test field personnel will be issued identification badges which will be worn during the course of field activities.

Access to the IC 31 worksite will be limited to authorized McClellan AFB, California EPA, U.S. EPA, other regulatory agencies and their representatives, HLA, and subcontractor personnel. Only visitors who have received prior authorization from appropriate project management or supervisory personnel to enter the worksite will be permitted entry.

The SSHO and project manager (PM) are responsible for coordinating site access control and security at IC 31. The site is enclosed by a fence posted with appropriate warning signs both restricting access and indicating the presence of hazards. Authorized visitors will be advised of the potential worksite hazards and will not be allowed to enter designated work zones unless they meet all required training/medical qualifications, read the HASP and agree to adhere to its requirements. A visitor log is maintained at the worksite, and all visitors will be required to sign in before entering designated IC 31 work zones.

### **8.2 Equipment Decontamination**

Much of the sampling and light equipment used at the worksite will be disposable. Reusable equipment will be decontaminated by washing, or a series of washings, using a detergent-water solution (Alconox® or Liquinox®) followed by a series of rinsings using generous amounts of water. The rinse water will be collected in clean containers for appropriate disposal, such as the SVE CatOx sedimentation unit for treatment prior to discharge to the McClellan AFB industrial water treatment plant.

The HLA FQCM, or designee, will ensure waste is properly containerized, secured, stored, and characterized, in accordance with the provisions of the McClellan AFB Hazardous Waste Management Plans, EPA guidance, and requirements of the McClellan AFB PM. Disposable PPE, equipment, plastic sheeting, and other non-hazardous wastes will be placed in plastic trash bags for disposal.

## **9.0 EMERGENCY RESPONSE PROCEDURES**

It is the policy of HLA to evacuate field personnel from a worksite during major incidents or emergencies (e.g., fires, explosions, major chemical releases, injuries, etc.), and to immediately notify and request assistance from agencies with personnel trained to deal with the specific emergency. In addition, McClellan AFB emergency response personnel will be notified of any releases and spills in accordance with procedures outlined in McClellan AFB's spill preventing Control and Countermeasures Plan (SPlan 19-2). This section describes contingencies and emergency response procedures to be implemented at the IC 31 worksite.

### **9.1 Emergency Assistance**

Table 3 provides a list of emergency telephone numbers and contacts. This list is posted or maintained at the worksite. In addition, maps indicating the location of the nearest emergency medical facilities on and off-base are also maintained at the worksite. Plates 1 and 2, Hospital Location Map, identify the locations and routes to McClellan AFB Clinic and the Mercy San Juan Hospital, respectively.

The following are the driving directions to the McClellan AFB Clinic:

- Drive 0.6 miles north on Dudley Boulevard until Palm Street
- Base Hospital is located at the southeast corner of Dudley Boulevard and Palm Street.

The following are the driving Directions to the off-base Mercy San Juan Hospital from IC-31:

- Drive 0.3 miles north on Dudley Boulevard
- Make a right onto Peacekeeper Way and proceed east
- Exit McClellan AFB through the Peacekeeper Gate
- Make a right onto Watt Avenue and proceed south
- Make a left onto Reseville Road
- Make a right onto Madison Avenue and proceed east
- Drive 1.8 miles to Auburn Boulevard
- Make a left onto Auburn Boulevard and proceed northeast
- Drive 1.9 miles to Greenback Lane
- Make a right onto Greenback Lane
- Make a right onto Park Oaks and proceed south
- Drive 0.6 miles south and make a left onto Coyle Avenue
- Hospital address and telephone number are:

Mercy San Juan Hospital  
6501 Coyle Avenue  
Carmichael, CA 95608  
(916) 357-5000

### **9.2 Potential Incidents**

Although unlikely, the following situations could occur and would require emergency response actions.

Release of Hazardous Vapors/Combustible Gases. In the event of a sudden release of hazardous vapors or gases constituting a potentially hazardous situation (e.g., adequate respiratory protection is unavailable, IDLH or explosive atmospheres, imminent worker or public safety or health hazards) the SSHO will halt operations and evacuate the IC 31 worksite, and notify McClellan AFB emergency response personnel. Personnel will evacuate the worksite to a location upwind and reconvene at a

prearranged safe location. Spill of Hazardous Liquid-Phase Products. In the event of a sudden spill of hazardous liquid-phase products constituting a potentially hazardous situation (e.g., adequate respiratory and dermal protection is unavailable, IDHL or explosive atmosphere, imminent worker or public safety or health hazard) the SSHO will halt operations and evacuate the IC 31 worksite, and notify McClellan AFB emergency response personnel. Personnel will evacuate the worksite to a location upwind and reconvene at a prearranged safe location.

Fire. Notify the McClellan AFB Fire Department and determine the extent of the fire. The SSHO or field team member present at the worksite will assess the hazard posed to site personnel, and whether or not it is safe to attempt to control or extinguish the blaze. Class A:B:C fire extinguishers are clearly marked and easily accessible to site personnel to control or extinguish small or incipient fires. If the fire cannot be controlled, the SSHO will attempt to shut off any equipment still operating, and evacuate personnel to a location upwind. Upon arrival of McClellan AFB Fire Department, the SSHO and authorized personnel present at the worksite will advise the on-site fire chief of the location, nature and types of hazardous materials, or other hazards on site.

Medical Emergency. In the event of a serious injury or illness, notify McClellan AFB emergency medical services (EMS) immediately. Workers with suspected back or neck injuries are not to be moved until emergency assistance personnel arrive. If there is evidence of serious trauma or unknown chemical exposure, the employee should be stabilized while awaiting EMS or rescue personnel. The SSHO as well as some other field personnel (e.g., the SVE CatOx SSHO) have current certification in first aid and CPR and will be able to provide emergency care while McClellan AFB emergency assistance, or EMS are notified. A first aid kit is available at the IC 31 worksite or HLA field vehicle for treating minor injuries.

Exposure. In the event of respiratory exposure, dermal or eye contact, or ingestion of a potentially toxic substance, the following procedures will be followed.

Respiratory Exposure (Inhalation). Move to fresh air immediately. Any loss of consciousness or exposure to elevated levels of known toxic substances, even if the individual appears to have fully recovered, requires immediate treatment or surveillance by a qualified physician.

Dermal Contact. Wash/rinse affected area for at least 15 minutes. An emergency drench system/eye wash is present at the IC 31 worksite. Transport worker to McClellan Clinic, Mercy San Juan Hospital, or another medical facility of the worker's choice, for treatment.

Eye Contact. Flush eye(s) continuously for 15 minutes using the emergency eye wash at the worksite, then transport worker to McClellan Clinic, Mercy San Juan Hospital, or another medical facility of the worker's choice. Follow-up treatment or examination by a qualified physician is required.

Ingestion. Notify McClellan Clinic or Mercy San Juan Hospital emergency medical facility, then immediately transport to the nearest available facility.

### **9.3 Communication Network**

A telephone or cellular telephone is available at the worksite. The SSHO will ensure that the communication network is in working order prior to and throughout FBAS treatability test activities.

### **9.4 Notification**

In the event of an injury-related accident, hazardous substance release, damage to government property, or emergency situations (existing or imminent), the SSHO must immediately (within 1 to 2 hours) notify appropriate McClellan AFB and HLA personnel. Personnel to be contacted include:

- HLA Project Manager (PM), David Hochmuth
- HLA Task Manager (TM), Michael Sides
- McClellan AFB Field Team Leader (FTL), Jerry Vincent
- McClellan AFB Remedial Program Manager (RPM), Craig Burnett
- McClellan AFB Contracting Officer, Kim Ford
- McClellan AFB Technology Program Team Leader (TPTL), Phil Mook
- HLA Project Safety and Health Officer (PSHO), Chris Corpuz

Refer to Table 3 for their telephone numbers.

Accidents and incidents will be reported to the PM and/or PSHO, and PSHM on an Accident Investigation Report (Attachment 4) within 24 hours of the incident. After an occurrence, the SSHO will remain at the site until released by the McClellan AFB Contracting Officer or RPM. The PM or PSHM will forward a copy of the Accident Investigation report to the McClellan AFB Contracting Officer and, if requested, the FTL. Circumstances of the accident/incident and preventative measures will be discussed during tailgate safety meetings and prior to reinstituting regular activities. The SSHO will investigate cause(s) and recommend appropriate control measures. The PSHM is responsible for reviewing the information and determining if further investigation or corrective measures are required. The SSHO will notify McClellan AFB and McClellan AFB will notify the state or federal agencies of any accidents, injuries, illnesses, or incidents (e.g., spills, releases).

Field personnel are responsible for reporting all work-related injuries or illnesses as soon as possible to the SSHO, PM, or PSHO. The PSHO is responsible for maintaining the H&S files of HLA personnel, including OSHA logs, training and medical surveillance certificates and records, and worker compensation files

#### **9.6 Exposure/Injury Medical Surveillance**

Any employee who suffers an illness, injury, or chemical exposure is required to see a physician. Depending upon the extent and type of exposure, illness, or injury, it is critical to perform follow-up testing within 24 to 48 hours. The PSHO will ensure that appropriate medical follow-up testing is conducted. The physician responsible for conducting the employee's medical surveillance examinations shall be notified and consulted to determine the type(s) of tests necessary to monitor the employee. A worker may return to work only with the written approval of the attending physician.

#### **9.7 Recordkeeping**

In addition to OSHA and Cal/OSHA recordkeeping requirements, the PSHO maintains a file of H&S related events occurring at HLA worksites. Any exposure or potential exposure are recorded, as well as accidents or incidents that require the filing of an Accident Investigation Report (e.g., injuries, illnesses, accidental damage to property, or "near miss" occurrences that could have resulted in personal injury).

## **10.0 HASP APPROVAL, REVIEW, AND DOCUMENTATION**

HLA field personnel will review the HASP during site-specific training and the initial FBAS treatability test briefing. Each field team member must sign the HASP Acceptance form (Attachment 5) and Personal Field Clearance Verification Log (Attachment 6). The forms will be maintained by the SSHO as part of the project H&S file.

The SSHO is responsible for informing all site personnel of any changes to the HASP and describing the specific details of the changes during safety meetings.

Field personnel will be advised of the results of any monitoring or sampling conducted during the FBAS treatment test related to possible exposure at the worksite. Any data or other documentation indicating possible employee exposure to chemical hazards exceeding PELs will be forwarded to the employee, the HLA and upon the employee's request, to his/her personal physician.

This HASP has been prepared for anticipated conditions at the IC 31 worksite, hazards, and tasks associated with the operation, maintenance and monitoring/sampling activities during the FBAS treatability test at the IC 31 worksite.

Table 1. Chemical Hazardous Properties  
Site-Specific Health and Safety Plan  
FBA System PRDA Test  
McClellan Air Force Base, IC-31  
Sacramento, California

Compound	CAS Number	Water Solubility <sup>a</sup>	Specific Gravity	Vapor Density	Flash Point (°F) <sup>b</sup>	Vapor Pressure <sup>c</sup>	LEL UEL	Ion Poten (eV)	TLV-TWA <sup>d</sup>	IDLH Level	Odor Thresh (ppm)	Haz Prop <sup>e</sup>	Acute Exposure Symptoms <sup>f</sup>
SPECIFIC CHEMICAL CONTAMINANTS													
Acetone	67-64-1	Miscible	0.8	2.0	0	180	2.5% 13%	9.69	250 ppm <sup>g</sup>	20,000 ppm	3.6-653	Fl, Tx, Vol	Diz, Drow, Eye, Resp, Skin
Ammonia	7664-41-7	Soluble	0.77	0.59	N/A	6400	10% 25%	10.18	25 ppm	500 ppm	17	Cor, Tx	Eye, Resp, Skin
Antimony	7440-36-0	Insoluble	6.89	N/A	N/A	0.0	N/A	N/A	0.5 mg/m <sup>3</sup>	80 mg/m <sup>3</sup>	N/I	Tx	Diar, Eye, Head, Vom
Arsenic	7440-38-2	— <sup>h</sup>	5.727	N/A	N/A	N/A	N/A	N/A	0.002 mg/m <sup>3</sup>	100 mg/m <sup>3</sup>	N/I	Tx, React, Ca	Abd, Coma, Conv, Diar, Fevr, Resp, Skin, Trem, Vom, Weak
Asbestos	1332-21-4	Insoluble	Variable	N/A	N/F	N/A	N/F	N/A	0.1 fibers/cc	N/E	N/A	Tx, Ca	Resp, Skin
Benzene	71-43-2	820 ppm	0.8785	2.8	12	75	1.3% 7.9%	9.24	1 ppm <sup>g</sup>	3000 ppm	34-119	Fl, Tx, Ca	CNS, Coma, Conv, Diz, Drow, Eye, Head, Naug, Resp, Skin, Trem, Vom, Weak
Beryllium	7440-41-7	— <sup>i</sup>	1.85	N/A	N/A	N/A	— <sup>j</sup>	N/A	0.5 µg/m <sup>3</sup> <sup>k</sup>	10 mg/m <sup>3</sup>	N/I	Tx, Ca	Resp, Weak
BHC, A, G (lindane)	58-89-9	Insoluble	1.85	N/A	N/A	0.32	N/A	N/I	0.5 mg/m <sup>3</sup>	1000 mg/m <sup>3</sup>	N/I	Tx, Ca	CNS, Eye, Resp, Skin
Boron	7440-42-8	Insoluble	2.45	N/I	N/I	11.856 x 10 <sup>3</sup> @ 2140°C	— <sup>j</sup>	N/A	N/I	N/I	N/I	Fl, React, Scarc Expl	N/I
Bromodichloromethane	75-27-4	Insoluble	1.980	N/I	N/F	N/A	N/F	N/I	N/E	N/E	N/I	Tx, Vol, Scarc	CNS, Eye, Resp, Skin
Bromoform	75-25-2	0.01 g	2.887	N/I	N/F	5	N/F	10.40	0.5 ppm	N/A	0.19-15	Fl	CNS, Conv, Eye, Head, Naus, Resp
n-butyl acetate	123-86-4	1%	0.88	N/I	72	15	1.7% 7.0%	10.00	150 ppm	10000 ppm	0.31-0.68	Fl	Head, Drow, Eye, Resp, Skin
Butyl benzyl phthalate	85-08-7	Insoluble	1.12	10.8	390	8.6 x 10 <sup>3</sup>	N/I	N/I	N/I	N/I	N/I	Fl, Tx	Skin
Cadmium	7440-43-9	— <sup>i</sup>	8.642	N/A	N/A	N/A	— <sup>j</sup>	N/A	5.0 µg/m <sup>3</sup>	50 mg/m <sup>3</sup>	N/I	Tx, Ca	Abd, CNS, Diar, Drow, Eye, Head, Naus, Resp, Skin Vom, Weak

Harding Lawson Associates

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Carbon disulfide	75-15-0	Slightly	1.2832	2.67	-22	297	1.3% 50.0%	10.08	1 ppm <sup>g</sup>	500 ppm	0.016-0.42	Fl, Tx	Eye, Head, Naus. Resp, Skin
Carbon tetrachloride	58-23-5	0.8%	1.5967	5.3	N/F	91	N/F	11.47	2 ppm	300 ppm	140-584	Tx, Vol, Ca	Abd, CNS, Coma, Diz, Dlar, Drow, Fevr, Head, Naus, Resp, Skin, Trem
Chloroethane (ethyl chloride)	75-00-3	0.8 g	0.8978	2.2	-58	1033.6	3.8% 15.4%	10.97	1000 ppm	20,000 ppm	N/I	Fl, Tx, Vol	CNS, Diz, Drow, Eye, Head, Resp, Skin, Uncon
2-Chloroethylvinyl ether	110-75-8	Insoluble	1.0475	3.7	80	30	N/I	N/I	N/E	N/E	N/I	Fl, Tx, Vol	Eye, Resp, Skin
Chloroform	67-66-3	0.8 g	1.4832	4.12	N/F	160	N/F	11.42	2 ppm	1000 ppm	133-276	Tx, Vol	CNS, Coma, Conv, Dlar, Eye, Head, Naus, Resp, Skin
Chloromethane (Methyl chloride)	74-87-3	0.74%	0.9159	1.8	32	38,000	8.1% 17.4%	11.28	5 ppm	10,000 ppm	>10	Fl, Tx, Vol, Ca	Abd, CNS, Coma, Conv, Conf, Diz, Dlar, Eye, Fevr, Head, Naus, Trem, Vom, Weak
2-Chlorophenol	95-57-8	Slightly	1.24	N/I	107	1.0	N/A	N/I	N/E	N/E	N/I	Cor, Tx	Eye, Resp, Skin
Chromium	7440-47-3	— <sup>i</sup>	7.20	N/A	N/A	N/A	— <sup>b</sup>	N/A	0.5 mg/m <sup>3</sup> <sup>h</sup>	N/E	N/I	Tx, Ca	Diz, Resp, Skin, Vom
Cobalt	7440-40-4	Insoluble	8.92	N/A	N/A	0.0	N/A	N/A	0.05 mg/m <sup>3</sup>	20 mg/m <sup>3</sup>	N/I	Tx	Skin
Copper	7440-50-8	— <sup>i</sup>	8.92	N/A	N/A	N/A	— <sup>b</sup>	N/A	1.0 mg/m <sup>3</sup>	N/E	N/I	Tx	Diz, Dlar, Eye, Fevr, Resp, Skin, Trem, Vom, Weak
Cyanides	57-12-5 (ion)	58 to 72%	1.5	N/A	N/F	0.0	N/F	N/A	5 mg/m <sup>3</sup>	50 mg/m <sup>3</sup>	N/I	Tx, React	Diz, Head, Naus, Resp, Uncon, Vom
Dibromochloromethane	124-48-1	Insoluble	2.451	N/I	N/I	N/I	N/I	N/I	N/E	N/E	N/I	Fl, Tx, Vol	CNS, Diz, Drow, Eye, Resp, Skin, Uncon, Vom
Di butylphthalate	84-74-2	Insoluble	1.05	9.58	322	1 mm @ 150°C	0.5% N/I	N/I	5 mg/m <sup>3</sup>	9300 mg/m <sup>3</sup>	N/I	Tx	Eye, Resp, Skin



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1,1-Dichlorobenzene (o-Dichlorobenzene)	95-50-1	Insoluble	1.234	N/A	150	1.2	2.2% 9.2%	9.06	25 ppm <sup>g</sup>	1000 ppm	0.70	Fl, Tx, Scarc	Diz, Eye, Head, Resp, Skin
1,4-Dichlorobenzene (p-Dichlorobenzene)	106-46-7	Slightly	1.30	N/A	151	1.2	2.2% 9.2%	8.98	10 ppm <sup>g</sup>	1000 ppm	0.12	Fl, Tx	Eye, Resp, Skin
Dichlorodifluoromethane	75-71-8	Insoluble	1.466 @ 30°C	4.1	N/A	3800 @ 16.1°F	N/A	11.75	1000 ppm	50,000 ppm	N/A	Tx, Vol	CNS, Conf, Diz
1,1-Dichloroethane (DXA)	75-34-3	0.1 g	1.1757	6.4	22	162	0% 16%	11.06	100 ppm	4000 ppm	49-1359	Fl, Tx, Vol	Abd, Diar, Drow, Eye, Resp, Skin, Trem
1,2-Dichloroethane (ethylene dichloride)	107-06-2	0.9%	1.2554	3.4	55	0.4	0.2% 10%	11.05	1 ppm	1000 ppm	6-111	Fl, Tx, Vol, Ca	CNS, Come, Diz, Diar, Eye, Naus, Resp, Skin, Trem, Vom
1,1-Dichloroethane (DCE) (Vinylidene chloride)	75-35-4	2250 mg/l	N/A	3.4	14	591	5.6% 11.4%	N/A	1 ppm	N/A	N/A	Fl, Tx, Vol, React, Ca	CNS, Eye, Resp, Skin
1,2-Dichloroethane	540-59-0	Soluble	1.27	3.34	N/A	N/A	9.7% 12.8%	9.65	200 ppm	4000 ppm	N/A	Fl, Tx, Vol	Eye, Resp, Skin
Dichloromethane (Methylene chloride)	75-09-2	Miscible	1.33	2.9	N/A	350	12% 19%	11.32	50 ppm	5000 ppm	N/A	Tx, Ca	Eye, Naus, Resp, Skin
1,3-Dichloropropane	542-75-0	Insoluble	1.2	3.8	83	28	5% 14.5%	N/A	1 ppm	N/A	N/A	Fl, Tx, Vol	Abd, CNS, Diar, Eye, Head, Naus, Resp, Skin, Trem
2,4-Dimethylphenol	105-67-9	Soluble	0.9650	N/A	>112	10 @ 92.3°C	N/A	N/A	N/A	N/A	N/A	Tx, Scarc	N/A
2,4-Dinitrophenol	51-28-5	5600 mg/l	1.683	6.35	N/A	2 x 10 <sup>4</sup>	N/A	N/A	N/A	N/A	N/A	Fl, Tx	Drow, Eye, Head, Resp, Skin, Uncon
Ethanol	64-17-5	Slightly	0.789	1.59	12.8	40	3.3% 19%	N/A	1000 ppm	N/A	49-710	Fl, Tx, Expl	Eye, Resp, Skin
Ethylbenzene	100-41-4	0.015 g	0.867	3.7	55	10	1.0% 0.75%	8.76	100 ppm	2000 ppm	0.092-0.80	Fl, Tx, Vol	Abd, CNS, Diz, Drow, Eye, Head, Naus, Resp, Skin, Uncon, Vom, Weak
Freon 113 (1,1,2-Trichloro-1,2,2-trifluoroethane)	76-13-1	Slightly	1.5635	6.5	N/A	284	N/A	N/A	1000 ppm	4500 ppm	N/A	Tx	Drow, Resp

Harding Lawson Associates

**Table 1. Chemical Hazardous Properties  
Site-Specific Health and Safety Plan  
FBA System PRDA Test  
McClellan Air Force Base, IC-31  
Sacramento, California**

Compound	CAS Number	Water Solubility <sup>a</sup>	Specific Gravity	Vapor Density	Flash Point (°F) <sup>b</sup>	Vapor Pressure <sup>c</sup>	LEL UEL <sup>d</sup>	Ion Potent (eV)	TLV-TWA <sup>e</sup>	IDLH Level	Odor Thresh (ppm)	Haz Prop <sup>g</sup>	Acute Exposure Symptoms <sup>f</sup>
Hexane	110-54-3	0.002%	0.66	2.97	-21.67°C	10	1.1% 7.5%	10.18	50 ppm	5000 ppm	65-248	Fl, Tx	Diz, Eye, Head, Naus, Resp, Skin
Iron	7439-89-6	Insoluble	7.87	N/A	N/A	N/A	— <sup>b</sup>	N/A	5 mg/m <sup>3g</sup>	N/E	N/I	Tx	Resp
Isopropanol (Isopropyl alcohol, 2-Propanol)	67-63-0	Soluble	0.79	2.08	53	33	2% 12%	10.10	400 ppm	12,000 ppm	37-810	Fl, Tx	Eye, Resp, Skin
Lead	7439-92-1	— <sup>i</sup>	11.3437	N/A	N/A	N/A	— <sup>b</sup>	N/A	0.05 mg/m <sup>3</sup>	700 mg/m <sup>3</sup>	N/I	Tx	Abd, Coma, Conv, Diz, Diar, Head, Trem, Vom, Weak
Magnesium	7439-95-4	Insoluble	1.74	N/A	N/A	N/A	— <sup>b</sup>	N/A	N/E	N/E	N/I	Fl, Rad	CNS, Resp, Vom
Manganese	7439-98-5	— <sup>i</sup>	N/I	N/A	N/A	N/A	— <sup>b</sup>	N/A	1 mg/m <sup>3g</sup>	N/I	N/I	Tx	CNS, Fevr, Weak
Mercury	7439-97-8	— <sup>i</sup>	13.5939	7.0	N/A	0.0012	— <sup>b</sup>	N/I	50 µg/m <sup>3g</sup>	28 mg/m <sup>3</sup>	N/I	Tx	Abd, Diar, Naus, Resp, Skin, Trem, Vom
n-ethyl butyl ketone (2-hexanone)	591-78-6	Slightly	0.801	3.5	64	16	1.2% 8.0%	9.34	1 ppm <sup>h</sup>	5000 ppm	0.068-0.085	Fl	Eye, Resp, Skin
Methylcyclohexane	108-67-2	Insoluble	0.7694	3.39	N/I	43	N/I	N/I	400 ppm	10,000 ppm	N/I	Fl, Tx	CNS, Diz, Eye, Resp, Skin
Methyl ethyl ketone (MEK, 2-Butanone)	78-93-3	353 g/l	0.805	2.41	16	77.5	1.4% 11.4%	9.54	200 ppm	3000 ppm	2-85	Fl, Tx	Diz, Eye, Head, Resp, Skin, Vom
Methyl isobutyl ketone (MIBK, hexone, 4-methyl-2-pentanone)	108-10-1	Slightly	1.33	2.93	22.78°C	380	1.4% 7.5%	N/I	50 ppm	5000 ppm	0.1-7.8	Fl, Tx	CNS, Conf, Eye, Resp, Skin
Methylene chloride	75-09-2	2%	1.335	22.9	None	350	14% 22%	11.32	50 ppm	5000 ppm	160	Tx, Vol, React	CNS, Coma, Eye, Head, Naus, Resp, Skin, Uncon, Weak
Molybdenum	7439-98-7	Insoluble	10.2	N/A	N/A	20	— <sup>b</sup>	N/A	10 mg/m <sup>3</sup>	N/I	N/I	Fl	Eye, Resp
Naphthalene	91-20-3	Insoluble	1.15	4.42	174	1 @ 52.6°F	0.9% 5.9%	8.12	10 ppm	500 ppm	0.038	Fl, Tx	CNS, Eye, Resp, Skin
Nicotel	7440-02-0	— <sup>i</sup>	8.9	N/A	N/A	N/A	— <sup>b</sup>	N/A	0.015 mg/m <sup>3g</sup>	N/E	N/I	Tx, Ca	Conv, Diar, Drow, Naus, Resp, Skin, Vom
2 Nitrophenol	88-75-5	Slightly	1.495	N/I	N/I	1 @ 49.3°C	N/I	N/I	N/I	N/I	N/I	Tx	Diz, Eye, Head, Skin, Uncon

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Table 1. Chemical Hazardous Properties  
Site-Specific Health and Safety Plan  
FBA System PRDA Test  
McClellan Air Force Base, IC-31  
Sacramento, California

Compound	CAS Number	Water Solubility <sup>a</sup>	Specific Gravity	Vapor Density	Flash Point (°F) <sup>b</sup>	Vapor Pressure <sup>c</sup>	LEL UEL <sup>d</sup>	Ion Poten (eV)	TLV-TWA <sup>e</sup>	IDLH Level	Odor Thresh (ppm)	Haz Prop <sup>g</sup>	Acute Exposure Symptoms <sup>f</sup>
Pentachlorophenol	87-86-5	Slightly	1.98	9.20	N/A	0.0001	N/A	N/A	0.5 mg/m <sup>3</sup>	150 mg/m <sup>3</sup>	N/I	Tx, Ca	Diz, Eye, Head, Naus, Resp, Skin, Vom, Weak
Phenol	108-95-2	8.4%	1.0576	3.2	175	0.4	1.8% 8.6%	8.50	5 ppm	250 ppm	0.60	Cor, Tx	Conv, Eye, Resp, Skin, Trem
Selenium	7782-49-2	Insoluble	4.5	N/A	N/A	N/A	N/A	N/A	0.2 mg/m <sup>3</sup>	N/E	N/I	Tx	Eye, Skin, Resp
Silver	7440-22-4	— <sup>h</sup>	10.5	N/A	N/A	N/A	— <sup>h</sup>	N/A	0.01 mg/m <sup>3</sup>	N/E	N/I	Tx	Eye, Skin
Tetrachloroethane (perchloroethylene)	127-18-4	0.15 g/ml	1.6227	5.8	N/F	14	N/F	9.32	25 ppm	500 ppm	47	Tx, Vol, Ca	Abd, Come, Diz, Drow, Eye, Head, Naus, Resp, Skin, Uncon
Tin	7440-31-5	Insoluble	5.75 7.28	N/A	N/A	N/A	— <sup>h</sup>	N/A	2.0 mg/m <sup>3</sup>	N/E	N/I	Tx	Abd, Head, Eye, Resp, Skin, Vom
Toluene	108-88-3	0.05 g	0.866	3.2	40	22	1.3% 7.1%	8.82	100 ppm	2000 ppm	1.6	Fl, Tx, Expl	CNS Conv, Conf, Diz, Drow, Eye, Head, Naus, Resp, Skin, Trem, Uncon, Vom, Weak
1,2,4-Trichlorobenzene	120-82-1	19 ppm	1.4542	6.26	105	0.29	2.5% 6.6%	N/I	5 ppm	N/I	N/I	Fl, Tx	Eye, Resp, Skin
1,1,1-Trichloroethane (TCA, Methyl chloroform)	71-55-6	0.7 g	1.3390	4.8	N/F	100	7.5% 12.5%	N/I	350 ppm	1000 ppm	390	Fl, Tx, Vol, React	Abd, CNS, Conv, Conf, Drow, Eye, Head, Naus, Skin, Trem, Uncon
Trichloroethane (TCE)	79-01-6	0.1%	1.4042	4.5	90	58	8% 10.5%	9.45	25 ppm	1000 ppm	0.25	Fl, Tx, Ca	CNS, Diz, Eye, Head, Naus, Skin, Trem, Uncon, Vom
Trichlorofluoromethane (Fluorotrichloromethane)	75-69-4	0.11 g	1.7	N/I	N/F	690	N/F	N/I	1000 ppm	10,000 ppm	N/I	Tx, Vol	CNS, Diz, Drow, Head, Naus, Vom
Vanadium	7440-02-1	Insoluble	7.14	N/A	N/A	N/A	— <sup>h</sup>	N/A	0.05 mg/m <sup>3</sup>	70 mg/m <sup>3</sup>	N/I	Tx	Eye, Resp, Skin
Vinyl chloride	75-01-4	Negligible	0.9100	2.24	-108	2515.0	3.6% 33%	9.99	1 ppm	N/E	10-20	Fl, Tx, React, Ca	Abd, CNS, Diz, Drow, Eye, Head, Naus, Resp, Skin, Weak

Harding Lawson Associates

**Table 1. Chemical Hazardous Properties  
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Compound	CAS Number	Water Solubility <sup>a</sup>	Specific Gravity	Vapor Density	Flash Point (°F) <sup>b</sup>	Vapor Pressure <sup>c</sup>	LEL UEL	Ion Potent (eV)	TLV-TWA <sup>d</sup>	IDLH Level	Odor Thresh (ppm)	Haz Prop <sup>e</sup>	Acute Exposure Symptoms <sup>f</sup>
Xylene (o.m.p)	1330-20-7	0.00003%	0.8642	3.7	63	7	1.1% 7%	8.56	100 ppm	1000 ppm	20	Fl, Tx, Vol	Abd, Diz, Drow, Eye, Naus, Resp, Skin
Zinc	7440-66-6	Insoluble	5.01	N/A	N/A	0 mmHg	—	N/A	5 mg/m <sup>3</sup>	N/E	N/I	Tx	Conv, Diz, Naus, Vom
GENERAL CHEMICAL CONTAMINANTS <sup>(h)</sup>													
Alcohols	none	N/A	N/A	N/A	N/A	N/A	N/E	N/A	N/E	N/E	N/E	Fl, Tx, Vol	CNS, Eye, Head, Naus, Resp, Skin, Uncon, Coma
Aldehydes	none	N/A	N/A	N/A	N/A	N/A	N/E	N/A	N/E	N/E	N/E	Fl, Vol, Tx	CNS, Eye, Head, Naus, Resp, Skin
Aliphatic/Cyclic Hydrocarbons	none	N/A	N/A	N/A	N/A	N/A	N/E	N/A	N/E	N/E	N/E	Fl, Tx, Ca, Vol	CNS, Eye, Skin, Resp
Aromatic Hydrocarbons	none	N/A	N/A	N/A	N/A	N/A	N/E	N/A	N/E	N/E	N/E	Fl, Tx, Ca, Vol	CNS, Eye, Diz, Head, Naus, Resp, Skin, Uncon, Conv Coma
BTEX	none	N/A	N/A	N/A	N/A	N/A	N/E	N/A	1 ppm <sup>1</sup>	N/E	N/E	Fl, Tx, Ca, Mut, Vol	CNS, Conv, Diz, Drow, Eye, Resp, Troun, Vom, Skin
Esters	none	N/A	N/A	N/A	N/A	N/A	N/E	N/A	N/E	N/E	N/E	Fl, Tx, Vol	Drow, Eye, Skin, Resp
Ethers	none	N/A	N/A	N/A	N/A	N/A	N/E	N/A	N/E	N/E	N/E	Fl, Tx, Vol, React	Drow, Eye, Skin, Resp, Uncon
Glycols	none	N/A	N/A	N/A	N/A	N/A	N/E	N/A	N/E	N/E	N/E	Fl, Tx, Vol	CNS, Eye, Skin, Resp
Halogenated Hydrocarbons	none	N/A	N/A	N/A	N/A	N/A	N/E	N/A	N/E	N/E	N/E	Fl, Tx, Ca, Vol	CNS, Eye, Head, Naus, Abd, Diz, Conv, Resp, Skin
Inorganic Solvents	none	N/A	N/A	N/A	N/A	N/A	N/E	N/A	N/E	N/E	N/E	Tx, Corr, React	Eye, Skin, Resp
Ketones	none	N/A	N/A	N/A	N/A	N/A	N/E	N/A	N/E	N/E	N/E	Fl, Tx, Vol	Eye, Skin, Head, Naus, Resp

Table 1. Chemical Hazardous Properties  
Site-Specific Health and Safety Plan  
FBA System PRDA Test  
McClellan Air Force Base, IC-31  
Sacramento, California

Compound	CAS Number	Water Solubility <sup>a</sup>	Specific Gravity	Vapor Density	Flash Point (°F) <sup>b</sup>	Vapor Pressure <sup>c</sup>	LEL UFL	Ion Poten (eV)	TLV-TWA <sup>d</sup>	IDLH Level	Odor Thresh (ppm)	Haz Prop. <sup>e</sup>	Acute Exposure Symptoms <sup>f</sup>
Nitro-hydrocarbons	none	N/A	N/A	N/A	N/A	N/A	N/E	N/A	N/E	N/E	N/E	Fl, Tx, Vol	CNS, Eye, Skin, Head, Naus, Resp
PAHs	none	N/A	N/A	N/A	N/A	N/A	N/E	N/A	0.2 mg/m <sup>3</sup>	N/E	N/E	Fl, Tx, Ca, Mut, Vol	CNS, Eye, Head, Naus, Resp, Skin
TPH	none	N/A	N/A	N/A	N/A	N/A	N/E	N/A	300 ppm*	N/E	N/E	Fl, Tx, Ca, Mut, Vol	CNS, Eye, Skin, Naus, Resp

< = less than

> = greater than

\*C = degrees Celsius

\*F = degrees Fahrenheit

µg/m<sup>3</sup> = micrograms per cubic meter

g = gram

g/ml = grams per milliliter

C = ceiling is the employee's exposure, which shall not be exceeded during any part of the work day

IDLH = immediate danger to life and health

lbs = pounds

LEL = lower explosive limit

m<sup>3</sup> = cubic meters

mg/l = milligrams per liter

mg/m<sup>3</sup> = milligrams per cubic meter

mg/kg = milligrams per kilogram

mm = millimeters

N/A = not applicable

N/E = none established

N/F = nonflammable

N/I = no information is available

ppb = parts per billion

ppm = parts per million

UFL = upper explosive limit

• Water solubility is expressed in different terms in different references. Many references use the term "insoluble" for materials that will not readily mix with water (e.g., gasoline). However, most of these materials are water soluble at the ppm or ppb level. Gasoline, for example, is insoluble in the gross sense and found as a discrete layer on top of the groundwater. But certain gasoline constituents (e.g., benzene, toluene, and xylene) are found in solution in the groundwater at the ppm or ppb level. Water solubility expressed as 0.2 g means 0.2 grams per 100 grams water.

• Several chlorinated hydrocarbons exhibit no flash point in the conventional sense but will burn in the presence of a high-energy ignition source or will form explosive mixtures at temperatures above 200°F.

• Expressed as millimeters of mercury (mm Hg) under standard conditions (20°F).

**Table 1. Chemical Hazardous Properties  
Site-Specific Health and Safety Plan  
FBA System PRDA Test  
McClellan Air Force Base, IC-31  
Sacramento, California**

4 Values for Threshold Limit Value - Time Weighted Average (TLV-TWA) are Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs) except where noted.\*

\* Hazard properties:

Ca = carcinogen  
Cocarc = cocarcinogen  
Cor = corrosive  
Expl = explosive  
Fl = flammable  
Inf = infectious  
Mut = mutagenic  
Narc = narcotic  
Rad = radioactive  
React = reactive  
Scarc = suspected carcinogen  
Tera = teratogen  
Tx = toxic  
Vol = volatile

† Acute exposure symptoms

Abd = abdominal pain  
CNS = central nervous system depression  
Coma = coma  
Conf = confusion  
Conv = convulsions  
Diar = diarrhea  
Diz = dizziness  
Drow = drowsiness  
Eye = eye irritation  
Fever = fever  
Head = headache  
Naus = nausea  
Nerv = nervousness  
Resp = respiratory system irritation  
Skin = skin irritation  
Sweat = sweating  
Trem = tremors  
Uncon = unconsciousness  
Vom = vomiting  
Weak = weakness

\* TLV-TWA adopted by the American Conference of Governmental Industrial Hygienists (ACGIH), which is lower than the OSHA PEL.

Table 1. Chemical Hazardous Properties  
 Site-Specific Health and Safety Plan  
 FBA System PRDA Test  
 McClellan Air Force Base, IC-31  
 Sacramento, California

- Explosive concentrations of airborne dust can occur in confined areas.
- Solubility of metals depends on the compound in which the metals are present.
- TLV-TWA recommended by the National Institute for Occupational Safety and Health (NIOSH), which is lower than the OSHA PEL.
- See information on specific compounds for more details.
- Based on benzene.
- Particulate PAHs.
- Based on gasoline.

**Table 2. Action Levels for Gases and Vapors  
Site-Specific Health and Safety Plan  
FBA System PRDA Test  
McClellan Air Force Base, IC-31  
Sacramento, California**

Direct-Reading Instrument	Frequency/ Duration of Air Monitoring	Action Level Above Background (a,b)	Contaminant	Monitoring/ Sampling Location	Action
PID	Continuous	0-1 ppm	Organic vapors	At source	Introduce engineering controls (i.e., blower fans) (Level C)
Vinyl Chloride Detector Tube	Measure at 1 ppm. indicated on PID (c).	1 ppm	Vinyl chloride present at $\geq 1$ ppm	At source	Upgrade to MSA gas mask with vinyl chloride cartridge (d) (call DSHO)
PID	Continuous	0-5 ppm	Vinyl chloride present at $\geq 1$ ppm	Breathing zone	MSA gas mask with vinyl chloride cartridge
PID	Continuous	5-50 ppm	Vinyl chloride present at $\geq 1$ ppm	Breathing zone	Level B supplied air
PID	Continuous	>50 ppm	Vinyl chloride present at $\geq 1$ ppm	Breathing zone	Stop work; leave area; call DSHO
PID or FID	Continuous	0-5 ppm	Vinyl chloride below 1 ppm	Breathing zone	Introduce engineering controls (i.e., blower fans), 1/2 face respirator; Level C
PID or FID	Continuous	5-25 ppm	Vinyl chloride below 1 ppm	Breathing zone	Continue engineering controls. Upgrade to full face respirator; Level C
PID or FID	Continuous	> 25	Vinyl chloride below 1 ppm	Breathing zone	Stop work; leave area; call DSHO.

(a) Action levels for known contaminants are based upon the contaminants Permissible Exposure Level (PEL) or Threshold Limit Values (TLVs), whichever is more conservative.



- (b) In situations where unknown contaminants are present, the action levels are based upon the following:

**HNu or OVA Measurements in Breathing Zone**  
**Continuous Reading for 1 minute**

Background	Level D
>0-5 ppm above background	Level C
5-500 ppm above background	Level B
500-1000 ppm above background	Level A

- (c) Frequency of detector tube monitoring for vinyl chloride will be task specific as determined by the SSHO, during sampling or intrusive activities.
- (d) Vinyl chloride cartridges are only approved by manufacturer for **4 HOURS** of continuous use in vinyl chloride environments.

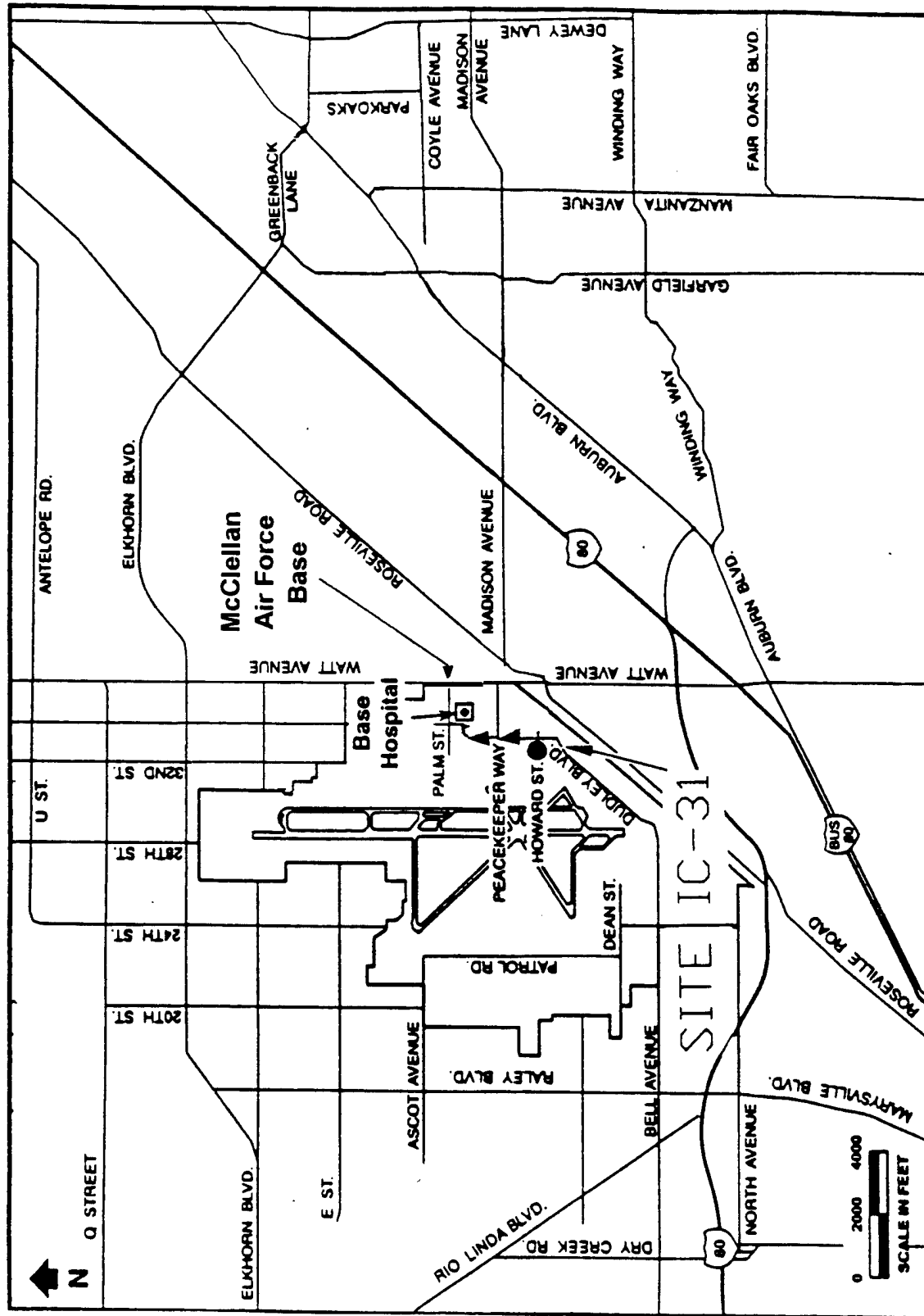
**NOTE:** At concentrations of 1 ppm or above, a colorimetric detector tube must be used to monitor for vinyl chloride. Follow actions detailed above. If no colorimetric tubes are available onsite to monitor for vinyl chloride, action levels shall assume 100 percent vinyl chloride in concentration detected.

**Table 3. Emergency Telephone Numbers  
Site-Specific Health and Safety Plan  
FBA System PRDA Test  
McClellan Air Force Base, IC-31  
Sacramento, California**

**EMERGENCY TELEPHONE NUMBERS**

Emergency Assistance Ambulance	116 (on base) or 115 (on base)
McClellan AFB Fire Department	117 (on base) (916) 643-6666 (off base)
McClellan AFB Security Police	112 (on base) (916) 643-6168 (off base)
<u>Duty Officer (Command Post)</u>	(916) 643-2751 (off base)
Site Contact (Craig Burnett, McClellan AFB Remedial Project Manager)	(916) 643-3672 x 327
McClellan AFB Clinic (Urgent Care Hours 0730 to 1900)	(916) 646-8420 (off base)
McClellan AFB Field Team Leader (Jerry Vincent)	(916) 643-0830 x 147 (off base) (916) 425-0431 (mobile) (916) 643-0788 #245 (pager)
Off-Base Hospital: Mercy San Juan Hospital 6501 Coyle Avenue, Carmichael CA 95608	(916) 537-5000
McClellan AFB Remedial Program Manager (Elaine Anderson)	(916) 643-0830 x 146
McClellan AFB Remedial Project Manager (Craig Burnett)	(916) 643-0830 x 171
McClellan AFB Technology Team Leader (Phil Mook)	(916) 643-5443
McClellan AFB Contracting Officer (Kim Ford)	(916) 643-0741
Utilities	(916) 643-4875 (off base)
HLA Field Supervisor, Alfonso Ang	(415) 884-3154 (415) 256-6568 (pager)
HLA Project Manager, David Hochmuth	(415) 884-3285 (415) 884-455-2156
HLA Task Manager, Michael Sides	(510) 628-3214 (510) 753-2368 (pager)
HLA Program Safety and Health Officer, Chris Corpuz	(415) 884-3149

To telephone McClellan AFB personnel while on base, dial only the last four numbers preceded by a "3" prefix (to call 643-6168 dial 3-6168).



PLATE

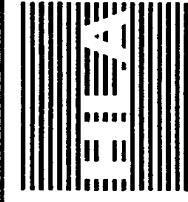
1

# Base Hospital Location Map

Work Implementation Plan  
McClellan Air Force Base  
Sacramento, California

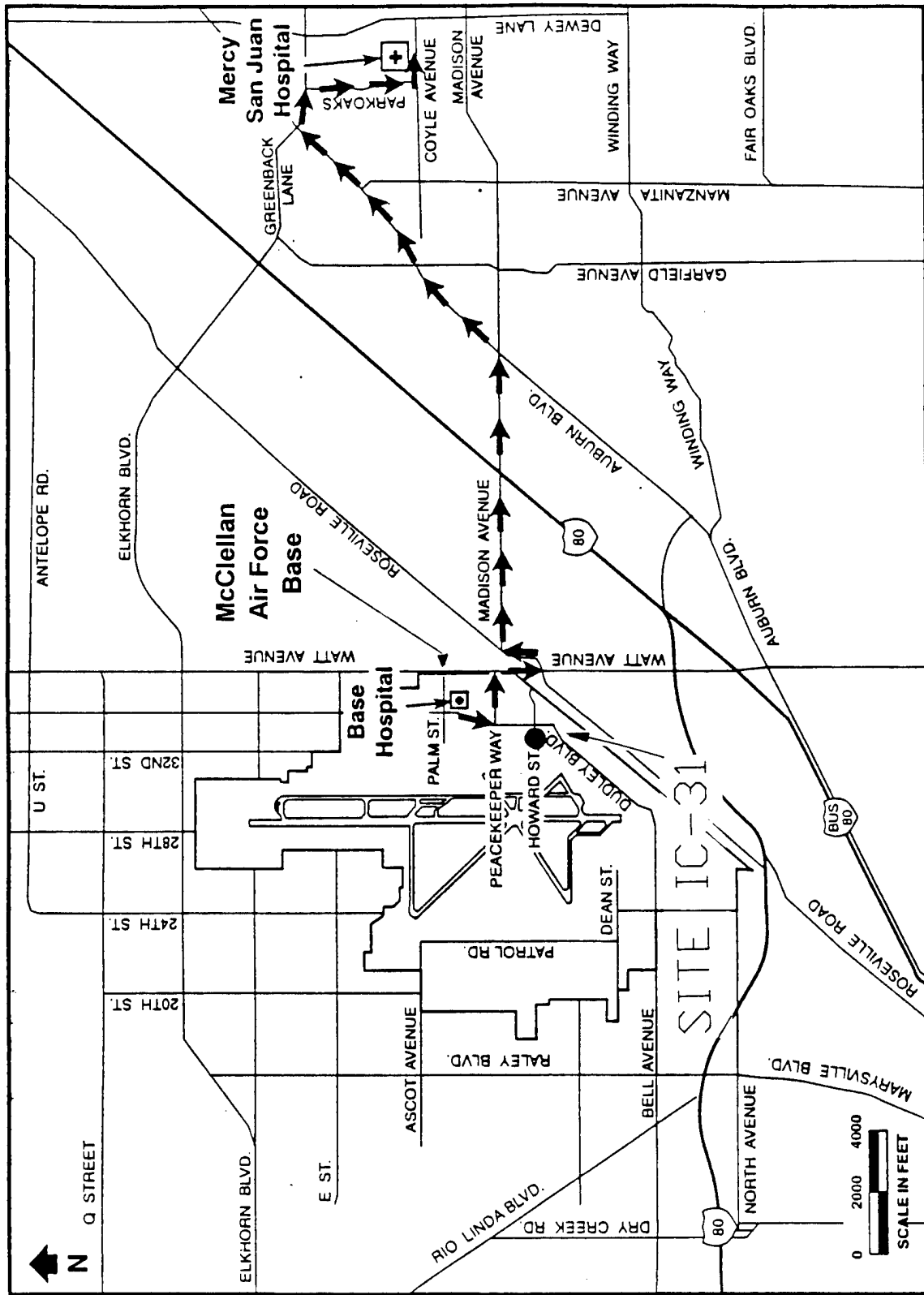
## Harding Lawson Associates

Engineering and  
Environmental Services



DRAWN TAG  
JOB NUMBER 37478.14

DATE 6/97  
REVISED DATE



**Harding Lawson Associates**

Engineering and  
Environmental Services

**Hospital Location Map**

Work Implementation Plan  
McClellan Air Force Base  
Sacramento, California

PLATE

**2**

DRAWN TAG	JOB NUMBER	APPROVED	DATE	REVISED DATE
	37478.14		2/97	

**APPENDIX C**  
**STANDARD OPERATING PROCEDURES**

## **Source Test Protocol**

Prepared for:  
Harding Lawson & Associates  
7655 Redwood Blvd.  
P.O. Box 578  
Novato, CA 94948  
Attn: Dave Hochmuth

Prepared by:  
BEST ENVIRONMENTAL Inc. (BEI)  
15890 Foothill Boulevard  
San Leandro, CA 94578-2101  
Phone (510) 278-4011  
Fax (510) 278-4018  
Attn: Craig Thiry

Date Issued 02/28/97

02 25 97 10:25 FAX 510 273 4018 BEST ENVIRONMENTAL

## SUMMARY INFORMATION

### Source Test Information

#### General Information

Source Owner: McClellan Air Force Base  
Source Location: McClellan Air Force Base  
?  
Phone: ?  
Contact: ?  
  
Source Description: Thermal Oxidizer  
  
Source Testing Firm: BEST ENVIRONMENTAL Inc. (BEI)  
15890 Foothill Blvd.  
San Leandro, CA 94578-2101  
Phone: (510) 278-4011  
Fax: (510) 278-4018  
Contact: Craig Thiry  
  
Proposed Testing Dates: ?

#### 1.0 Introduction:

The Source testing program objective is to determine NO<sub>x</sub>/SO<sub>2</sub> emissions.

#### 2.0 Emission Source Information:

MAFB operates a thermal oxidizer located at ??? used for ????

Exhaust Gas Temperature ~ ? °F  
Exhaust Gas Flow rate DSCFM ~ ?  
Exhaust Gas Moisture ~?

The exhaust stack is ? in diameter. Ports are located >? diameters downstream of any disturbances and >? diameter upstream of the stack exit. Two ports are located 90° apart.

#### 3.0 Source Testing Program Description:

The exhaust stack will be tested for SO<sub>2</sub>, NO<sub>x</sub>, and O<sub>2</sub>.

#### 4.0 Source Testing Procedures:

This section is intended to provide an overview of the sampling strategy and does not attempt to summarize the sampling procedures which are described in detail in the reference methods. Examples of the sampling data recording forms are contained in the appendix.

CARB Method 100 (NO<sub>x</sub>, SO<sub>2</sub>, O<sub>2</sub>), and/or CARB Method 6/8 (SO<sub>2</sub>) will be used to determine emission compliance. CARB Method 100 continuously extracts sample from the exhaust stack conditioned and analyzed by continuous monitoring gas analyzers in a test van. The sampling system consists of a stainless steel sample probe, heated Teflon sample line, glass-fiber particulate filter, glass moisture-condensation knockouts, Teflon sample transfer tubing, diaphragm pump and a stainless steel/Teflon manifold and flow control system. A constant sample and calibration gas supply pressure of 5 PSI is provided to the each analyzer to avoid pressure variable response errors.

The entire sampling system is leak checked before and after the sampling program. The BEI sampling and analytical instruments are checked for linearity with zero, mid and high span calibrations. If necessary, system bias is determined by pulling calibration gas through the entire sampling system. Individual test run calibrations will use the calibration gas which most closely matches the stack gas effluent. The calibration gases will be selected to fall approximately within 80 to 90 percent for the range. Zero and calibration drift values will be determined for each test.

All calibration gases are EPA Protocol #1 rated or are traceable to the National Institute of Standards and Technology. Calibration gas certificates will be included in the final test report. The analyzer data recording system consists of Hewlett Packard Model 7132 dual-channel or Linear-3 channel strip chart recorders plus a data acquisition system. The following continuous monitoring analyzers or equivalents will be used:

<u>Parameter</u>	<u>Make Model</u>	<u>Principle</u>
SO <sub>2</sub>	Western Research 721A	Ultra-Violet
NO <sub>x</sub>	TECO 10	Chemiluminescence
O <sub>2</sub>	Siemens 5E	Paramagnetic

The following expected concentrations and calibration ranges are proposed. Certain gases may be substituted depending on availability at the time of testing.

	<u>Expected</u>	
SO <sub>2</sub>	?	Range 0-?
NO <sub>x</sub>	?	Range 0-?
O <sub>2</sub>	?	Range 0-?

CARB Method 6 and or 8 may be used in lieu of CARB Method 100 for SO<sub>2</sub> determination. The integrated sampling procedure allows the measurement of sulfur dioxide in the impinger fraction. To measure sulfur emissions, the first impingers will be charged with 80% IPA, and the second with 3% H<sub>2</sub>O<sub>2</sub>.

Project organization/key personnel: The key individuals employed by BEST ENVIRONMENTAL are listed below. The positions to which they are primarily assigned are described below.



**Regan Best/Source Test Manager:** Mr. Best has 21 years of experience in air emissions testing. Mr. Best has been a working partner at BEST ENVIRONMENTAL since 1987, and previously worked for Acurex Corp. and Ultrachem. Mr. Best would provide technical advice and project review as well as performing field sampling as needed.

**Craig Thiry/Operations Manager:** Mr. Thiry has 14 years of experience in air emissions testing. Mr. Thiry has previously worked for Clean Air Engineering and TMA/Norcal. Mr. Thiry's duties include scheduling, marketing, procurement, client interface and field sampling. Mr. Thiry provides field support services, client/regulatory liaison and performs field sampling as needed.

**Daniel Cartner/Project Manager:** Mr. Cartner has 12 years experience in air emissions testing. Mr. Cartner has been a working partner at BEI since 1988, and has previously worked for Clean Air Engineering, Steiner Environmental and ERG at various locations in the United States. Mr. Cartner functions as a Senior Project Manager performing field sampling.

**Guy Worthington/Project Manager:** Mr. Worthington has over 10 years of experience in air emissions testing. Mr. Worthington has held group management positions at Galson Corp. and TMA/Norcal, and has RCRA Trial Burn testing and management experience. Mr. Worthington would also serve as a Senior Project Manager.

**Scott Chesnut/Project Manager:** Mr. Chesnut has 8 years experience in air emissions testing. Mr. Chesnut is BET's latest Project Manager hire, and has previously worked for Brown & Caldwell and TMA/Norcal at various locations in the United States. Mr. Chesnut functions as a Project Manager performing field sampling.

#### **5.0 QA & QC Procedures:**

**QA/QC Program** All quality assurance and quality control procedures will be followed as prescribed in the appropriate methods and technical guidance manuals.

Adherence to QA/QC procedures during field test preparation and field sampling will be the responsibility of the QA/QC Officer and/or Project Manager. This test program would include all QA/QC procedures specified in the test methods (equipment calibration, field data recording, contamination control and record keeping). Analytical QA/QC protocol will be the responsibility of the Analytical Liaison, and the laboratory manager and QA/QC coordinator assigned to this program by the laboratory we have subcontracted. Any deviations from stated protocols not mentioned herein would be discussed with the appropriate individuals prior to implementation.

**Chain of Custody:** A sample is considered to be under a person's custody if (1) if in a person's physical possession, (2) in view of the person after he has taken possession, (3) secured by that person that no one can tamper with the sample, or (4) secured by that person in an area which is restricted to authorized personnel. The following steps are taken to ensure sample identification and integrity:

- 1) Sample labels (identity, #, date, time)
- 2) C.O.C. seals (with sample #)
- 3) Field sample log book and field notes
- 4) C.O.C. record and analysis request sheet
- 5) Shipping papers (Courier, Fed. Ex.)
- 6) Receiving/Log-in (signed receipt of samples and their condition)

Once the sample has been received in the laboratory and the status of the sample integrity has been determined, the lab QA/QC supervisor is responsible for care and custody. The lab should be prepared to testify to the possession and security of the sample until analysis is complete.

In addition to the QA/QC procedures mentioned, BEI participates in EPA audits and uses EPA Protocol or 1% NIST Traceable calibration gases.

#### **6.0 Source Test Report:**

Data reduction/reporting procedures: All data reduction is performed using Lotus or Excel spreadsheet programs developed by BEI. The report will be written by a senior project manager and will be reviewed by his peers. All supporting documentation, field data sheets, lab reports, lab and field QA/QC reports, emission calculations, etc., will be included in the final report. Calculations are contained in the referenced methods and in the APCD/AQMD source Test Procedure Guidelines where applicable.

The expected date for a final report is approximately two weeks after the analytical work is completed. The analytical turn around time is approximately two weeks.

Submitted by,

Craig Thiry  
Operations Manager

@ AIR TOXICS LIMITED  
STANDARD OPERATING PROCEDURE

ANALYSIS OF VOLATILE ORGANIC COMPOUNDS IN Summa<sup>tm</sup> POLISHED  
CANISTERS

EPA METHOD TO-14

SOP # 6

Effective Date: 1/15/97  
Revision #: 8  
Reason for Revision: To add sections 2.6 and 2.7, update  
sections 6.1.2, 6.1.3, 6.1.6 and 6.4.7  
and amend the table in section 6.1.7  
and Appendix A

Updated By:	<u>Mika Greenfield</u>	<u>MIKA GREENFIELD</u>	<u>CHEMIST</u>	<u>1/20/97</u>
	Signature	Print	Title	Date
Technical Review:	<u>Diane Page</u>	<u>Diane Page</u>	<u>Chemist</u>	<u>1-20-97</u>
	Signature	Print	Title	Date
QA Review:	<u>Isabella C. Cune</u>	<u>Isabella C. Cune</u>	<u>QA Manager</u>	<u>1/15/97</u>
	Signature	Print	Title	Date
Laboratory Director:	<u>Robert Freeman</u>	<u>Robert Freeman</u>	<u>Tech Dir.</u>	<u>1/20/97</u>
	Signature	Print	Title	Date
	Linda L. Freeman			

## 1.0 PURPOSE

- 1.1 To provide a procedural guide for the application of EPA Method TO-14 to the analysis of volatile organic compounds in ambient air using evacuated stainless steel summa canister collection. The EPA method is followed without modification.
- 1.2 To describe specific adaptations of the method to the analysis of the EPA Clean Air Act List of target compounds.

## 2.0 PROCEDURES

- 2.1 EPA Method TO-14 describes techniques for the analysis of airborne VOCs collected as whole air samples in stainless steel canisters. One liter of air is withdrawn from the canister through a mass flow controller and cryofocused at  $-189^{\circ}\text{C}$  in a dewar of liquid argon. The focused air sample is then flash heated through a hydrophobic drying system which removes water from the sample stream prior to analysis by full scan GC/MS.

### 2.2 Materials, Supplies and Equipment

25  $\mu\text{L}$ , 500  $\mu\text{L}$ , 1 mL, 2.5 mL, 5 mL and 25 mL gastight syringes (CMS)  
Certified NIST Traceable VOC blends - Scott Specialty Gases  
Aldrich Chemical High Purity Near Standards (Lab Certified)  
Tedlar Bags (1L, 3L and 10L) SKC  
Heating Tapes - Various Lengths (Cole Palmer)  
Power Controllers (Cole Palmer)

HP 5970, HP 5971 and HP 5972 MSDs with UNIX Operating System/Thru-Put Software  
NIST/NBS54.1K Library Search Software  
RTX-624 105 m X 0.53 mm Megabore<sup>TM</sup> column

Liquid Argon 5500 cu. ft. dewar (Local Supplier)  
Ultra High Purity Helium (Local Supplier)  
Liquid cryogenic dewars (300 mL, 500 mL, 5000 mL) CMS

Laboratory designed cryofocusing TO-14 interface equipped with six port heated (at ca.  $180^{\circ}\text{C}$ ) Valco valve for sampling and backflushing contents of the cryotrap to the drier. The cryotrap consists of 1/8 inch stainless steel tubing packed with acid washed glass beads and wrapped around a cartridge heater (at ca.  $175^{\circ}\text{C}$ ). The cryofocusing unit is attached to the drier by a 1/16 inch stainless steel heated transfer line maintained at ca.  $65^{\circ}\text{C}$ . Purge/Desorption Gas flow is regulated by a flow controller on the canister interface. Canisters are connected to the cryofocusing unit

through a 5 micron particulate filter. Optional syringe injection of gaseous standards is accomplished through a Swagelok T equipped with septum cap just prior to the sampling valve.

Laboratory designed drying system which consists of a 1/8 inch packed tube containing a hydrophobic sorbent housed in a heated block. Water passes through the drier at ambient temperature while organic VOCs are retained. Following the drying cycle, the tube is heated to 270°C and the VOCs are backflushed to the GC/MS through a heated fused silica transfer line connected to the packed column injection port.

Tylan Mass Flow Control Module (1 to 100 mls/min. Air)  
Edwards Vacuum Pump

Laboratory Designed Heated Dynamic Gas Dilution Manifold - based on Porter flow controllers and Sierra digital flow sensors for calibration and diluent gases

Laboratory Designed Canister Receiving Station equipped with high resolution vacuum/pressure gauge and diluent gas inlet.

- 2.3 Analysis is carried out on a GC/MS system equipped with a Megabore™ inlet adapter, cryogenic oven controller, a J&W Scientific RTX-624 column and a Hewlett-Packard 5970, 5971 and 5972 Mass Selective Detectors. The detectors are equipped with a jet separators.

- 2.4 The GC/MS operating conditions include:

Column: 105 m x 0.53mm RTX-624 (Restek)

Injector Temperature: 150°C

Oven ramp: 40°C for 5 min., 5°/min. to 180°C for 3 min.

Carrier Gas: UHP Helium at 15 mLs per min.

Separator Temperature: 220°C

Source Interface Temperature: 250°C

Scan: Low mass 35 amu (29 amu when analyzing for Methanol)

High mass 350 amu

Scan rate: 2 seconds per scan

Drier Purge Time : 8 to 10 minutes

Drier Desorb Preheat Temperature: 240 to 245°C

Drier Desorb Temperature: 250°C

Drier Desorb Time: 3 to 10 minutes

Bake Temperature: 270°C

Bake Time: 8 to 10 minutes

Trap/Drier Carrier Flow: 25 mLs per minute UHP Helium

Note: the drier conditions are optimized for each unit with the above as guidelines.

Canister Interface Valve/Line Temperature: 150°C

Sample Volume: Cryotrap 20 min. @ 50 mL/min. (1 Liter)

Desorption Temperature Cryotrap: 150°C

Desorption Time Cryotrap: 8 min.

- 2.5 Quantitation is based on the internal standard technique. The internal standards, Bromochloromethane, Chlorobenzene-d5 and 1,4-Difluorobenzene are spiked into each standard, blank, sample and QC sample at 50 ppbv. Also spiked into all standards, blanks, samples and QC samples are three surrogates. The surrogates Octafluorotoluene, Toluene-d8 and 4-Bromofluorobenzene are spiked at 50 ppbv.
- 2.6 Normal laboratory safety precautions must be used when preparing standards from neat materials and when analyzing samples for this method. These precautions include working in a fume hood, wearing eye protection and wearing a laboratory coat when handling neat materials. Also, precautions must be taken to avoid skin contact with neat materials. Refer to the compound specific MSDS for additional information. Care must also be taken when handling syringes to ensure that a needle stick does not occur. Canisters must be handled in such a manner as to avoid releasing sample into the air. The procedures described in this SOP are designed for skilled chemists trained in the safe operation of analytical gas chromatographic equipment and sample handling.
- 2.7 Interferences to this method generally include high levels of either Carbon Dioxide, water and/or heavy hydrocarbons. High levels of CO2 in the samples can cause freezing of the cryotrap and thus a flow drop on the sample interface. When this occurs a smaller amount of sample is collected resulting in higher dilution factors. Very high levels of moisture in the samples cause erratic Internal Standard and Surrogate responses and therefore likely erratic target responses. When a sample has high levels of heavy hydrocarbons, the analyst may have to dilute the sample more than the target compound level requires to ensure the system is not contaminated.

### 3.0 CANISTER MOUNTING AND SPIKING PROCEDURES

- 3.1 Upon receipt, the canister vacuum/pressure is recorded. Under normal field conditions the canisters will either be at ca. 10"Hg vacuum or ambient pressure. Canister receipt vacuum/pressure is reported on the

front page of the data report. If abnormal conditions exist the project contact is notified by the sample custodian or a client services representative before analysis can begin. Data from such samples will be qualified. Prior to analysis, the canister is pressurized to 5 psig for 6 L canisters and 15 psig for 1 L canisters.

- 3.2 Canisters are connected to the inlet line of the cryofocusing unit with 1/4" stainless steel fittings. Connections are leak checked by monitoring the flow on the Tylan controller. As vacuum is achieved, the flow will drop to zero. After leak checking is complete, the valve on the canister is opened and flow allowed to equilibrate for 1 minute. The equilibration period also allows for sweeping of the line/trap.
- 3.3 Sampling is initiated by rotating the Valco six port valve into the sample position. Air from the canister flows into the cryotrap which is placed in a dewar of liquid argon. Sampling continues for a period of 20 minutes or until the desired volume of air has been withdrawn. During this time, a 1 cc gas sample valve injection of IS/Surrogates is made.
- 3.4 Following the 20 minute sampling period, the six port valve is rotated into the backflush position, the Dewar of liquid argon removed and the trap heater turned ON. Contents of the cryotrap are then swept by carrier gas into the drier for a period of 8 to 10 minutes. Following this time period, the drier is flash heated and the contents backflushed into the GC/MS over a 10 minute period of time. A 10 to 15 minute bake cycle is then used to clean the system for the next sample. The bake cycle eliminates sample carryover by sweeping both the heated trap and heated drier to vent.

#### 4.0 **QUALITATIVE ANALYSIS**

##### 4.1 **Qualitative Target Compound Identification**

4.1.1 An analyte is qualitatively identified when two criteria are met:

- 1) The Relative Retention Time (RRT) for the analyte must be within +/- 0.06 RRT units of the RRT of the analyte in the daily continuing calibration check.
- 2) Ions present in the standard spectrum greater than 10% of the most abundant ion must be present. Also, the relative intensity of the ions greater than 10%, must be +/-20% of the intensity in the standard spectrum. The standard spectrum is generated by the system that is performing the analysis. See *Appendix E* for a list of the Quantitation Ions used for each compound.

It may be necessary for the analyst to perform manual background subtraction of coeluting peaks to obtain a clean spectrum. The analyst must always use their discretion on any identification.

#### 4.2 Tentatively Identified Compounds (TIC)

4.2.1 When requested, the analyst searches the ten highest non-target unknown peaks. The spectrum of these peaks are searched against the NIST library of greater than 50,000 compounds. The analyst evaluates the top three library searches to determine the tentative identity of the unknown compound. Based on the computer generated searches, the identification is assigned. The analyst must use their discretion on any identification.

4.2.2 The total ion current is used for quantitation and calculation of TIC results. The total ion current of the closest (by Retention Time) internal standard is used to calculate results. A relative response factor of "1" is assumed.

### 5.0 CALCULATIONS

Response Factors:

$$\text{Relative Response Factor (RRF)} = \frac{\text{Area of Compound}}{\text{Area of Internal Std.}} \times \frac{\text{Concentration of Int. Std. (ppbv)}}{\text{Concentration of Compound (ppbv)}}$$

Results Calculation:

$$\text{ppbv On Column} = \frac{\text{Area of Compound in Sample}}{\text{Area of Int. Std. in Sample}} \times \frac{\text{Concentration of Int. Std. (ppbv)}}{\text{Continuing Calibration Check's RRF}^*}$$

$$\text{ppbv In Sample} = \text{ppbv On Column} \times \text{Dilution Factor}$$

Note: The dilution factor includes canister pressurization dilution and any subsequent dilution required to ensure all results are within the instrument calibration range.

\* The average RRF from the initial calibration curve is used as projects specify.

### 6.0 QUALITY CONTROL

#### 6.1 Preparation of Standards

6.1.1 Calibration is performed at a minimum of five levels. One standard must be at or near the reporting limit. Standards are prepared from laboratory certified Aldrich neat materials and NIST Traceable Scott Specialty Gas VOC blends. Standards prepared in neat form are first subject to capillary GC/FID analysis to determine purity. The percent purity must be greater than 96% or correction factors are used. Following the purity check, the



standards are blended into the working range by taking known aliquots and using density based calculations.

#### 6.1.2 Certified Gas Blends

The original 40 component TO-14 list of analytes is purchased from Scott Specialty Gases (See *Appendix H*) blended to 5 ppmv in a high pressure cylinder. The blend is produced by the manufacturer using criteria designed to minimize vapor phase interactions and maximize long term stability.

#### 6.1.3 Certified Calibration Blend

Inject 480 mLs of the 5 ppmv certified TO-14 standard into an evacuated 6.0 L canister which contains 50  $\mu$ L of water. This canister is then used for the combined standard described in section 6.1.6.

#### 6.1.4 Laboratory Blends from Neat Materials

Analytes not present in the Scott Gas blends were purchased in neat form from Aldrich Chemical Company. These compounds are blended in the gas phase by attaching a Tedlar bag to the TO-14 blending manifold and filling with UHP N<sub>2</sub> to an accurately measured volume of 1, 3 and 10 liters. After the gas has filled the bag, prescribed amounts of the neat material are injected into the bag. Density based calculations are used to determine the prescribed amounts and final concentrations. (Note: Tedlar bags are used for the static dilution medium due to their inherent inertness to polar analytes vs. glass dilution jars. Standards should not however be stored in the Tedlar bags beyond 3 days. Fresh calibration standards are prepared and then transferred in final form to Summa canisters for storage. The standards in Summa Canisters must be discarded after 6 months.)

#### 6.1.5 Neat Materials Calibration Blend

Spike appropriate amounts of neat from *Appendix B* into a 10 L Tedlar Bag filled with 8 L of UHP Nitrogen. The resulting concentration is 100 ppmv. The 100 ppmv standard is drawn into an evacuated 6 L Summa canister. The Summa canister is pressurized from 0 "Hg to 15 psig for a dilution of 1:2.02. The final concentration of the standard is 50 ppmv.

#### 6.1.6 Combined Calibration Blend

For the combined standard, 48 mLs of the neat laboratory blended standards described in sections 6.1.4, 6.1.5 and 6.1.6 are added to the certified TO-14 standard canister described in section 6.1.3. After bringing

the canister to 15 psi (a 1:2 dilution), the final concentration of all analytes is 200 ppbv. Aliquots are then introduced by mass flow controller. Standards prepared in this manner may be used for up to 1 month from date of preparation.

#### 6.1.7 Internal Standard/Surrogate Mix

Blend the prescribed amount of neat material into a Tedlar bag to a final volume of 8.0 liters. Transfer the contents of the Tedlar bag to an evacuated Summa canister and pressurize to 20 psig. The final concentration is 50 ppmv. This type of standard may be used for up to 6 months.

	COMPOUND	DENSITY	FW	μL	ppmv
	Bromochloromethane	1.991	129.39	2.6	120
	Chlorobenzene-d5	1.157	117.60	4.0	118
	1,4-Difluorobenzene	1.110	114.09	4.0	117
(Surrogate)	Octafluorotoluene	1.666	236.06	5.6	119
(Surrogate)	Toluene-d8	0.943	100.21	4.2	119
(Surrogate)	4-Bromofluorobenzene	1.593	175.01	4.3	118

#### 6.2 Five Point Multilevel Calibration

The five point calibration is constructed by loading varying amounts of the Combined Calibration Blend on the canister interface. The standard volume of air withdrawn is one liter, consequently lower loadings result in an effective dilution.

CAL 1	2.0 or 5.0 ppbv *
CAL 2	5.0, 10 or 25 ppbv *
CAL 3	50 ppbv
CAL 4	100 ppbv
CAL 5	200 ppbv

\* Some compounds do not respond well and therefore the CAL 1 and CAL 2 points may vary by compound.

Always introduce 1.0 mL of the IS blend described in Section 6.1.7 into the canister interface as each standard or sample is being loaded. The IS amount loaded in this fashion will be 50 ppbv per component.

#### 6.3 BFB Check Mix

Spike 625 μL of certified 2000 μG/mL 4-Bromofluorobenzene (see Appendix C) standard into 50 mL of Methanol. The final concentration is

25  $\mu\text{G/mL}$  or 25  $\text{nG}/\mu\text{L}$  of 4-Bromofluorobenzene. A 2.0  $\mu\text{L}$  of this standard is injected for the 50  $\text{nG}$  on column tune check.

#### 6.4 Calibration and QC Checks

- 6.4.1 Calibration of the GC/MS is achieved via the internal standard technique. The response factor variability over the 5 point curve may be  $\pm 30\%$  RSD. (See Appendix D.) A second source check is analyzed after each initial curve, to verify that the standards are correct.
- 6.4.2 Daily, a Continuing Calibration Check (CCC) is performed after the BFB tune check which is the start of every 24 hour clock. The CCC sample consists of the mid-level calibration standard. For the "Standard" TO-14 list compounds (See Appendix A), the relative percent difference for 90 % of the check compounds must be  $\leq 30\%$  from the five point average for the calibration to still be valid. For the "Non-standard and Polar" TO-14 list compounds (See Appendix A), the relative percent difference for 80 % of the check compounds must be  $\leq 40\%$  from the five point average for the calibration to still be valid. If the CCC fails to meet the performance criteria then maintenance should be performed and the test repeated. If the system still fails the calibration check, a new 5 point calibration curve is performed. The sample results are calculated using the relative response factors from the daily calibration check or from the average from the initial curve if that is required by the project.
- 6.4.3 A laboratory fortified method spike is prepared by spiking all target species into humidified zero grade air at a concentration near the mid-low or mid point of the calibration curve (ca. 25 or 50 ppbv). The percent recovery (%R) acceptance criteria is  $\pm 70 - 130\%$  for the "Standard" TO-14 list compounds (See Appendix A). The %R acceptance criteria is  $\pm 60 - 140\%$  for the "Non-standard and Polar" TO-14 compounds (See Appendix A). When requested, the method spike and method spike duplicate are analyzed at a 10% frequency. The method spike %Rs are reported with the analytical results when sample duplicate analyses are reported.
- 6.4.4 A laboratory blank is run after the CCC at the beginning of each day and at least once in every 24 hour shift. Laboratory blanks should be run after every high level sample to demonstrate that contamination does not exist in the chromatographic system. The acceptance criteria for reagent blanks is for contamination less than the laboratory detection limit except for common lab solvents such as methylene chloride which should be less than 5X the reporting limit.
- 6.4.5 A daily tune check with 4-Bromofluorobenzene (BFB) is achieved by injecting 2  $\mu\text{L}$  (50  $\text{nG}$ ) of the BFB Check Sample in accordance with CLP

tuning criteria. Analysis cannot proceed unless all criteria (*Appendix F*) of the tune check are met.

- 6.4.6 The method analysis sequence is as follows and repeats every 24 hours (every 12 hours when project specified):

Initial 24 hour period:      BFB Tune Check  
                                     5 Point Calibration  
                                     Laboratory Blank  
                                     Samples

Subsequent 24 hour period: BFB Tune Check  
                                     CCC Check/Method Spike  
                                     Laboratory Blank  
                                     Samples

The "Subsequent 24 hour" sequence is followed each twenty four hour period (every 12 hours when specified by the project) that samples are analyzed, until the system is found to be out of calibration.

- 6.4.7 All Internal Standard areas of the Laboratory Blank and all samples must be within  $\pm 30\%$  of the CCC's Internal Standard area (a warning limit of  $\pm 20\%$  is used to investigate possible mis-injection of Int. Std.). The Retention Time of the Internal standard must be within  $\pm 0.5$  min. of the CCC's Internal Standard Retention Time. When samples are analyzed on the same 24 hour clock as the initial calibration curve, the mid-point standard will be used for evaluation of Internal Standards. If either of the above criteria are not met, the sample (or blank) must be analyzed again (unless an obvious matrix interference is documented). If the criteria is still not met (it must be met for the blank, before analyses may continue), then the data is reported from the first analysis and the matrix effect narrated in the laboratory narrative included with the data report. Upon request, the data from the matrix effect confirmation analysis is provided to the client.

- 6.4.8 All Surrogate Recoveries of the Laboratory Blank and all samples must be within 70% to 130%. If the recovery limits are not met, the sample (or blank) must be analyzed again (unless an obvious matrix interference is documented). If the limits are still not met (they must be met for the blank, for analyses to continue), then the data is reported from the first analysis and the out of limit surrogate flagged with a "Q" qualifier. The "Q" qualifier is defined in the data package. For CLP-like packages, the qualifier is defined in the laboratory narrative.

- 6.4.9 A duplicate sample analysis is performed on 10% of the samples. The Relative Percent Difference (RPD) between the two analyses must be  $\leq$  30% RPD for all compounds detected at greater than 5 times the LOQ. If this limit is exceeded, the sample is re-analyzed a second time. If the limit is exceeded again, the cause is investigated and the system brought back to working order. If no problem is found on the system, the data is reported and a note describing the non-conforming event is provided with the final report.
- 6.4.10 Method Detection Limit Studies (MDL) are analyzed as described in 40 CFR Pt. 136 App.B. The MDL determines the 99% confidence level for seven replicates of a low level standard. The MDL is defined as 3.14 times the standard deviation of the seven replicates. See *Appendix G* for the MDL study results

## **7.0 DELIVERABLES**

### **7.1 Standard (Non-CLP-like) Data Reporting Package**

An example of a commercial data package reporting format appears in *Appendix J*. The header contains information containing to date of sampling, date of analysis, dilution factor and unique laboratory identifiers for both the sample and the analysis files. The table of target analytes follows with information provided for adjusted detection limit and amount detected. Surrogate recovery information appears generally at the bottom of the table along with QC acceptance windows.

A computer generated diskette may be specified by the project and is available in a variety of format styles (DBASE III, Lotus, ASCII or customized ). It is the responsibility of the Systems Manager to oversee the generation of the diskettes and to review their content prior to submission.

### **7.2 LEVEL IV - EPA CLP-like Reporting Package**

A Level IV data package contains all of the elements of a full CLP style deliverable. See *Appendix K* for an example. The deliverable includes:

- Cover Sheet - Sample ID's and Dates Received
- Laboratory Narrative
- Volatile Organic Analysis Sheets
- Tentatively Identified Compound Sheets
- Method Blank Summary Sheets
- Internal Standard Retention Time and Area Count Sheet
- Surrogate Percent Recovery Sheet

Multilevel Calibration Summary Sheet

BFB Tune Sheet

Copies of COC, Airbills and Sample Tags

All associated instrument raw data and laboratory notebook run logs

LIST OF APPENDICES

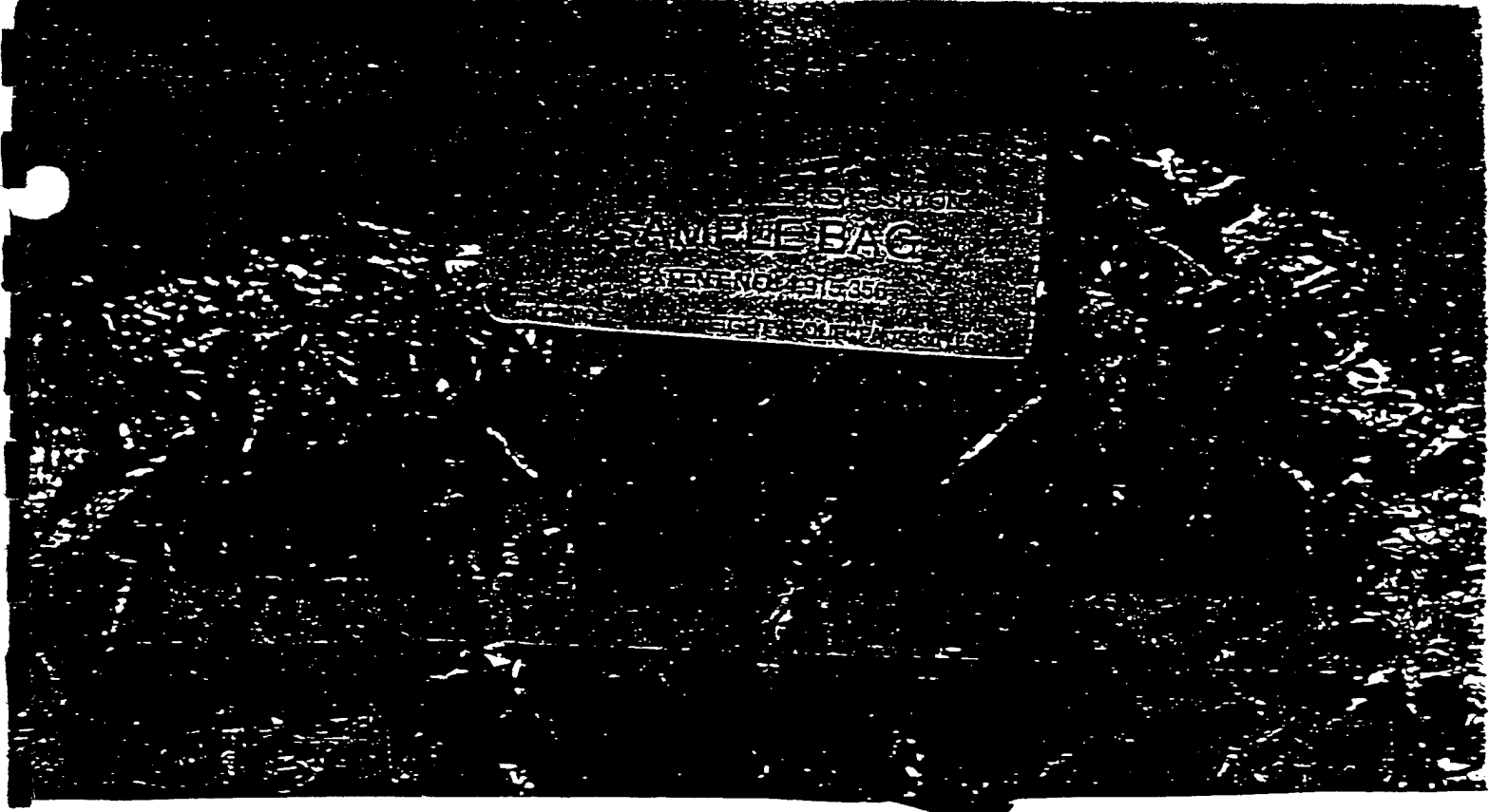
- A. COMPOUNDS AND REPORTING LIMITS
- B. NEAT MATERIALS MIX - DENSITY/SPIKE AMOUNTS
- C. BFB CHECK MIX
- D. INITIAL CALIBRATION DATA
- E. QUANTITATION IONS
- F. BFB TUNE CRITERIA
- G. METHOD DETECTION LIMIT STUDY
- H. Scott Specialty Gas Blend CERTIFICATES OF ANALYSIS
- J. Non-CLP-like REPORTING FORMAT
- K. LEVEL IV - CLP-like REPORTING FORMAT

## Appendix B

ATLIST.XLS 6/21/95 1:09 PM

6/21/95		8 Liter Gas Standards							
Compound	Supplier	Lot#	unit	CAS #	density	FW	uL	PPM	
1,3-Butadiene	Aldrich	14030MZ	99%	106-99-0	GAS	N/A	0.3ml	100	
Propylene	Aldrich	10619DY	99+%	115-07-1	GAS	N/A	0.3ml	100	
Cyclohexane	Aldrich	01314LV	99+%	110-82-7	0.779	34.16	3.6	100	
n-Octane	Aldrich	00801MX	99+%	111-65-9	0.703	114.23	5.4	100	
Bromoform	Aldrich	10226MX	99+%	75-25-2	2.894	252.75	2.9	100	
Acetone	Sig-Aldrich	06247BF	99+%	67-64-1	0.791	58.08	2.5	102	
Chloroprene	hem Service	54-72A	50%	126-99-8	0.958	88.00	<del>3.2</del>	105	
Bromodichloromethane	Aldrich	08830EY	99+%	75-27-4	1.980	163.83	2.3	102	
Carbon Disulfide	EM	32324	99+%	75-15-0	1.266	76.14	2.0	100	
Chlorodibromomethane	Aldrich	00925HP	98+%	124-48-1	2.451	208.29	2.9	103	
Vinyl Acetate	Aldrich	05530AY	99+%	108-05-4	0.934	86.09	3.1	101	
2-Propanol	B&J	AS575	99+%	67-63-0	0.785	60.1	2.6	102	
Tetrahydrofuran	Aldrich	07815CX	99+%	109-99-9	0.886	72.11	2.7	100	
1,2-Dichloroethene	Aldrich	10406EY	98+%	150-60-5	1.257	96.94	2.6	101	
MEK	Aldrich	09119JW	99+%	78-93-3	0.805	72.11	3.0	101	
MIBK	Aldrich	01427LW	99+%	108-10-1	0.812	86.13	3.6	102	
2-Hexanone	Aldrich	01418BM	99+%	591-78-6	0.812	100.16	4.1	100	
4-Ethyl Toluene	Aldrich	00103DM	98+%	622-96-8	0.861	120.2	4.6	99	
1,4-Dioxane	Aldrich	02502CX	99+%	123-91-1	1.034	38.11	2.9	102	
MTBE	Aldrich	02409EW	99+%	1634-04-1	0.758	88.15	3.9	101	
Ethanol	Aldrich	01218JY	95%	64-17-5	0.785	46.07	2.0	102	
Heptane	Aldrich	04410HV	99+%	142-82-5	0.684	100.21	4.9	101	
2-Chloroethylvinylether	Aldrich	12011EW	99%	110-75-8	1.048	106.55	3.5	104	
Hexane	Aldrich	01517CZ	99%	110-54-3	0.659	86.18	4.5	103	
Plus 20.0ul of H2O									
Procedure: Measures 8L nitrogen into a Tedlar bag and spike in amounts of analytes listed in the table. Chloroprene is 50% in xylene, so spike twice the amount listed for chloroprene.									

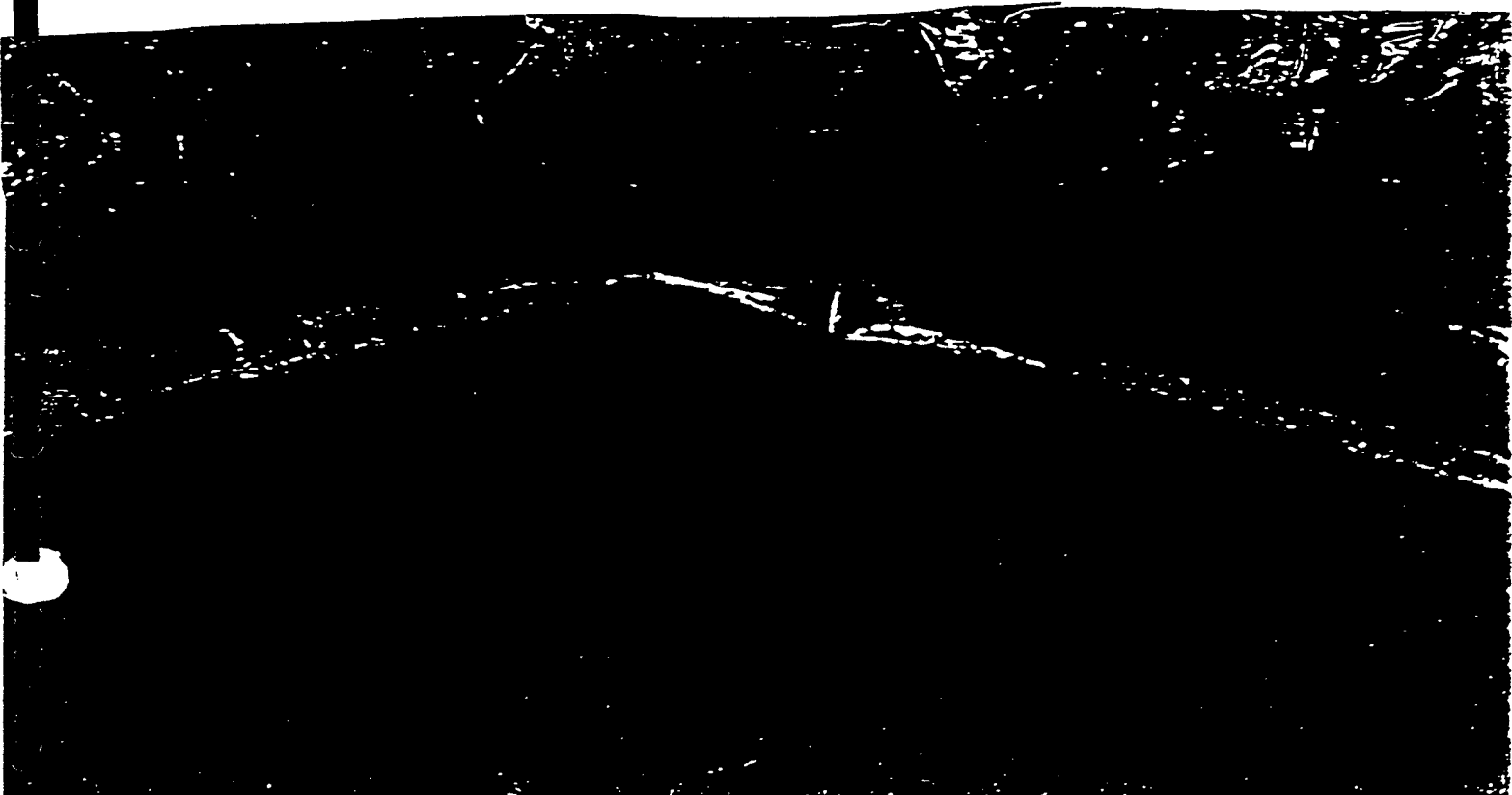
64



Appendix 3 - cont.

BENZYLCLXLS

3 Liter Gas Standards								
Compound	LOT#	SUPPLIE	PURITY	CAS #	density	FW	uL	PPM
Chloride	12127cx	ALDRICH	99%	100-44-7	1.100	126.59	3.9	102
ene	03701DZ	ALDRICH	99%	100-42-5	0.909	104	3.9	102





STD. I.D.

207-21

Date

10/6/95

Analyst

R/r

Appendix C

ULTRA SCIENTIFIC

250 Smith St., North Kingstown, RI 02852  
401-294-9400

PURGEABLE SOLMS CALIBRATION STANDARD

STS-110

1 mL

100% METHANOL

A2LA CERTIFIED CERTIFICATION # 003105

Lot No.

G-3862

Exp. Date 7/96

Each ampoule contains the following  
component at 2000 µg/mL in methanol.

4-bromofluorobenzene (BFB)

0.25 mL of BFB was  
spiked into MeOH.  
the final volume = 50 mL  
final concentration =

$$(x \text{ mL})(2000 \text{ µg/mL}) = (50 \text{ mL})(25 \text{ µg/mL})$$

$$x = 0.625 \text{ mL}$$

$$= 0.625 \text{ mL}$$

ULTRA Scientific

250 Smith Street  
North Kingstown, RI 02852

STS-110-1

4-BROMOFLUOROBENZENE  
SOLUTIONMaterial Safety Data  
Sheet (MSDS) Available

A2LA CERTIFIED

1 x 1 mL

For Research Use Only

401-294-9400



meat lot # = 34333  
omniSol

Continued on Page

Read and Understood By

Beky Murois 10/6/95  
Signed Date

Alpha Greenfield  
Signed

10-6-95  
Date

5ppm 100-point used for 1,4-Dioxane and Ethanol

2ppm 100-point for Bromoform taken from file # 5102403

4-Point used on Vinyl Acetate

Report Date : 25-Oct-1995 00:24

Appendix D

Page 1

# Air Toxics Limited

## INITIAL CALIBRATION DATA

Start Cal Date : 21-SEP-95 19:13  
End Cal Date : 24-OCT-1995 18:53  
Quant Method : ISTD  
Origin : Force  
Target Version : 3.10  
Integrator : HP Genie  
Method file : /chem/msd5.i/5-24oct95.b/TO14-1024AT.m  
Cal Date : 25-Oct-1995 00:22 msd5  
Curve Type : Average

### Calibration File Names:

Level 1: /chem/msd5.i/5-24oct95.b/5102410.d  
Level 2: /chem/msd5.i/5-24oct95.b/5102405.d  
Level 3: /chem/msd5.i/5-24oct95.b/5102406.d  
Level 4: /chem/msd5.i/5-24oct95.b/5102407.d  
Level 5: /chem/msd5.i/5-24oct95.b/5102408.d

Compound	2 Level 1	25 Level 2	50 Level 3	100 Level 4	200 Level 5	RRF	% RSD	
1 FC-72(1)	-----	-----	-----	-----	-----	-----	-----	<-
(2)	0.60686	315	-----	-----	-----	158	140.877	<-
2 Chlorodifluoromethane/FR22	-----	-----	-----	-----	-----	-----	-----	<-
3 Propylene	0.79036	0.71098	0.64174	0.68151	0.63453	0.69182	9.133	
4 DICHLOROFLUOROMETHANE/FR 12	3.80352	3.72555	3.52816	3.46377	3.16302	3.53680	7.095	
5 FREON 114	3.96616	4.01442	3.35129	3.83155	3.37012	3.30671	6.720	
7 1-Butene	1.45018	-----	-----	-----	-----	1.45018	0.000	
6 CHLOROMETHANE	0.82597	0.90609	0.99715	0.82716	0.73831	0.35894	11.344	
10 Methanol	-----	-----	-----	-----	-----	-----	-----	<-
8 VINYL CHLORIDE	1.00511	1.12570	1.06170	1.08248	0.93795	1.04259	6.986	
9 1,3-Butadiene	0.41160	0.63062	0.58714	0.67918	0.62923	0.58736	17.636	
11 BROMOMETHANE	1.14523	1.14663	1.06522	1.08121	0.93912	1.07548	7.871	
13 Ether	-----	-----	-----	-----	-----	-----	-----	<-
14 Vinyl Bromide	-----	-----	-----	-----	-----	-----	-----	<-
15 Pentane	-----	-----	-----	-----	-----	-----	-----	<-
12 CHLOROETHANE	1.01698	0.81456	0.76989	0.73729	0.62384	0.79251	18.163	
17 Bromoethane	-----	-----	-----	-----	-----	-----	-----	<-
16 TRICHLOROFLUOROMETHANE/ FR 11	3.63765	4.01125	3.81280	3.64974	3.12506	3.64730	9.017	
18 Cyclopentane	-----	-----	-----	-----	-----	-----	-----	<-
20 Freon 123	-----	0.94316	0.87354	0.80711	-----	0.87460	7.779	<-
21 Acrolein	-----	-----	-----	-----	-----	-----	-----	<-
19 Ethanol	0.29829	0.19818	0.19914	0.26897	0.24005	0.24090	18.152	
24 Methyl Iodide	-----	-----	-----	-----	-----	-----	-----	<-
22 FREON 113	3.31123	4.21426	4.01924	3.38068	3.33858	3.85280	8.463	
13 1,1-DICHLOROETHENE	1.57487	1.65953	1.61022	1.55083	1.32184	1.54346	8.453	
25 Acetone	1.44800	1.20411	1.05375	1.34308	1.27465	1.26472	11.729	
28 Allyl Chloride	1.52744	2.01662	1.35281	1.85622	2.11479	1.37357	11.911	



## Air Toxics Limited

## INITIAL CALIBRATION DATA

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 Quant Method : ISTD  
 Origin : Force  
 Target Version : 3.10  
 Integrator : HP Genie  
 Method file : /chem/msd5.i/5-24oct95.b/TO14-1024AT.m  
 Cal Date : 25-Oct-1995 00:22 msd5  
 Curve Type : Average

Compound	2 Level 1	25 Level 2	50 Level 3	100 Level 4	200 Level 5	RRF	% RSD
64 TRICHLOROETHENE	0.55792	0.56161	0.53353	0.53022	0.49216	0.53509	5.197
65 Methyl Methacrylate	-----	-----	-----	-----	-----	-----	<-
67 Ethyl Cellosolve	-----	-----	-----	-----	-----	-----	-----
68 Dibromomethane	0.56713	-----	0.57334	0.45681	-----	0.53243	12.313 <-
66 1,2-DICHLOROPROPANE	0.44033	0.49071	0.47137	0.45938	0.43004	0.45836	5.281
69 1,4-Dioxane	0.08719	0.13879	0.13636	0.19181	0.19281	0.14960	29.625
70 Bromodichloromethane	0.34134	0.56837	0.49492	0.66631	0.62960	0.54011	23.835
71 DMOS	-----	-----	-----	-----	-----	-----	<-
72 c-1,3-DICHLOROPROPENE	0.35140	0.44222	0.44643	0.46173	0.44691	0.42974	10.334
75 2,4-Pentanedione	-----	-----	-----	-----	-----	-----	-----
73 4-Methyl-2-pentanone	0.94770	0.56466	0.56466	0.80615	0.76334	0.72930	22.632
78 Iso-Butyl acetate	-----	-----	-----	1.30320	-----	1.30320	0.000 <-
77 TOLUENE	0.65174	0.67661	0.63313	0.64738	0.62407	0.64659	3.109
76 Octane	0.38449	0.38534	0.31705	0.42025	0.39397	0.38022	10.038
79 t-1,3-DICHLOROPROPENE	0.19989	0.19806	0.23268	0.23429	0.24491	0.22197	9.693
82 1,3-DICHLOROPROPANE	-----	-----	-----	-----	-----	-----	<-
80 1,1,2-TRICHLOROETHANE	0.61283	0.66623	0.65867	0.62539	0.61370	0.63536	3.992
84 Butylesteraceticacid	-----	-----	-----	-----	-----	-----	<-
81 TETRACHLOROETHENE	0.90351	0.97568	0.93412	0.85888	0.83729	0.90190	6.200
83 2-Hexanone	0.60852	0.41488	0.37208	0.45556	0.44048	0.45830	19.580
85 Dibromochloromethane	0.65791	0.88292	0.78805	1.02291	1.00032	0.87042	17.445
86 1,2-DIBROMOETHANE	0.75346	0.94651	1.00790	0.99488	0.99581	0.93971	11.359
87 Nonane	-----	-----	-----	-----	-----	-----	<-
89 CHLOROBENZENE	1.11333	1.15024	1.15089	1.08810	1.10066	1.12064	2.564
90 ETHYL BENZENE	0.65279	0.77166	0.74471	0.73619	0.73723	0.72852	6.136
91 m,p-XYLENE	0.84338	0.90266	0.86576	0.87413	0.86316	0.86982	2.477
92 Cellosolve Acetate	-----	-----	-----	-----	-----	-----	-----
94 Isopropylbenzene	-----	-----	-----	-----	-----	-----	<-
96 Butyl Cellosolve	-----	-----	-----	-----	-----	-----	-----
93 o-XYLENE	0.55150	0.62228	0.58878	0.56622	0.57991	0.58174	4.590
5 STYRENE	0.93877	0.64025	0.70006	0.96224	1.03105	0.85447	20.240
97 Cyclohexanone	-----	-----	-----	-----	-----	-----	-----
99 Cumene	-----	-----	-----	-----	-----	-----	<-
98 Bromoform	0.46858	0.42365	0.37517	0.52997	0.52036	0.46350	14.092

## Air Toxics Limited

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 Integrator : HP Genie  
 Method file : /chem/msd5.i/5-24oct95.b/TO14-1024AT.m  
 Cal Date : 25-Oct-1995 00:22 msd5  
 Curve Type : Average

Compound	2 Level 1	25 Level 2	50 Level 3	100 Level 4	200 Level 5	RRF	% RSD	
101 Decane	-----	-----	-----	-----	-----	-----	-----	<-
102 n-Propylbenzene	-----	-----	-----	-----	-----	-----	-----	<-
103 1,1,2,2-TETRACHLOROETHANE	1.06504	1.24208	1.22886	1.16975	1.24568	1.19028	6.418	
104 4-Ethyltoluene	0.35367	0.65063	0.62681	0.57319	0.59697	0.56025	21.267	
105 3-Octanone	-----	-----	-----	-----	-----	-----	-----	
105 1,3,5-TRIMETHYLBENZENE	1.98399	1.51744	1.24827	1.35270	1.75010	1.67050	17.440	
107 alpha-Methyl Styrene	-----	-----	-----	-----	-----	-----	-----	<-
109 1,2,3-Trimethylbenzene	-----	-----	-----	-----	-----	-----	-----	<-
110 sec-Butylbenzene	-----	-----	-----	-----	-----	-----	-----	<-
108 1,2,4-TRIMETHYLBENZENE	1.26878	1.03731	0.97889	0.87810	0.96852	1.02636	14.326	
111 p-Cymene	-----	-----	-----	-----	-----	-----	-----	<-
112 Dicyclopentadiene	-----	-----	-----	-----	-----	-----	-----	<-
113 1,3-DICHLOROBENZENE	0.83586	1.01072	1.01993	0.94885	1.03969	0.97101	8.530	
114 1,4-DICHLOROBENZENE	1.23519	1.14855	1.06541	0.97753	1.08303	1.10194	8.739	
115 BENZYL CHLORIDE	0.74571	0.69183	0.75679	1.05039	1.21765	0.89247	25.727	
116 1,2-DICHLOROBENZENE	1.11058	0.89373	0.91154	0.82589	0.89912	0.92817	11.559	
117 1,2-D8-3CPA	-----	-----	-----	-----	-----	-----	-----	<-
118 1,3,5-Trichlorobenzene	-----	-----	-----	-----	-----	-----	-----	<-
119 Isophorone	-----	-----	-----	-----	-----	-----	-----	<-
120 1,2,4-TRICHLOROBENZENE	0.27276	0.23550	0.34596	0.33063	0.38839	0.31465	19.261	
121 HEXACHLOROBUTADIENE(1)	0.75099	0.64309	0.56426	0.44531	0.50120	0.58097	20.493	
(2)	0.48971	0.41070	0.36248	0.28646	0.31566	0.37300	21.586	
\$ 52 Octafluorotoluene	2.71702	2.61782	2.65043	2.51332	2.52310	2.60434	3.319	
\$ 74 Toluene-d8	0.85079	0.90260	0.88075	0.91933	0.90673	0.89204	3.019	
\$ 100 3FB	0.91386	1.00876	0.98928	1.01823	1.00898	0.98782	4.320	

# Appendix E QUANTITATION IONS

Parameter	Mass (amu)
Freon 12 (Dichlorodifluoromethane)	85
Chloromethane	50
Freon 114	135
Vinyl Chloride	62
Bromomethane	94
Chloroethane	64
Freon 11 (Trichlorofluoromethane)	101
1,1-Dichloroethene (1,1-Dichloroethylene)	61
Methylene Chloride	49
Freon 113	151
1,1-Dichloroethane	63
cis-1,2-Dichloroethene (cis-1,2-Dichloroethylene)	61
Chloroform	83
1,1,1-Trichloroethane	97
Carbon Tetrachloride	117
Benzene	78
1,2-Dichloroethane	62
Trichloroethene (Trichloroethylene)	95
1,2-Dichloropropane	63
cis-1,3-Dichloropropene	75
Toluene	91
trans-1,3-Dichloropropene	75
1,1,2-Trichloroethane	97
Tetrachloroethene (Tetrachloroethylene)	166
1,2-Dibromoethane (EDB)	107
Chlorobenzene	112
Ethylbenzene	91
m,p-Xylene (1,3 and/or 1,4-Dimethylbenzene)	91
o-Xylene (1,2-Dimethylbenzene)	91
Styrene	104
1,1,2,2-Tetrachloroethane	83
1,3,5-Trimethylbenzene	105
1,2,4-Trimethylbenzene	105
1,2-Dichlorobenzene	146
1,4-Dichlorobenzene	146
1,3-Dichlorobenzene	146
Chlorotoluene (Benzyl Chloride)	91
1,2,4-Trichlorobenzene	180
Hexachlorobutadiene	225

Appendix E  
QUANTITATION IONS continued

Parameter	Mass (amu)
Propylene	41
1,3-Butadiene	54
Acetone	43
Carbon Disulfide	76
Isopropanol	45
trans-1,2-Dichloroethene	96
Vinyl Acetate	43
Chloroprene	53
2-Butanone (Methyl Ethyl Ketone)	43
Hexane	57
Tetrahydrofuran	42
Cyclohexane	56
1,4-Dioxane	88
Bromodichloromethane	83
4-Methyl-2-Pentanone (MIBK)	43
2-Hexanone	43
Dibromochloromethane	129
Bromoform	173
4-Ethyltoluene	105
Ethanol	45
Methy t-Butyl Ether (MTBE)	73
Heptane	43
<u>Surrogates</u>	
Octafluorotoluene	217
Toluene-d8	98
4-Bromofluorobenzene	95
<u>Internal Standards</u>	
Bromochloromethane	130
1,4-Difluorobenzene	114
Chlorobenzene-d5	117

## Appendix F

### Methods for Determination of Toxic Organic Compounds in Air

Table 4. 4-BROMOFLUOROBENZENE KEY IONS AND ION ABUNDANCE CRITERIA

Mass	Ion Abundance Criteria
50	15 to 40% of mass 95
75	30 to 60% of mass 95
95	Base Peak, 100% Relative Abundance
96	5 to 9% of mass 95
173	<2% of mass 174
174	>50% of mass 95
175	5 to 9% of mass 174
176	>95% but < 101% of mass 174
177	5 to 9% of mass 176



## Appendix G

Report Date : 24-Apr-1995 12:50

Q Air Toxics Ltd.  
METHOD DETECTION LIMIT SUMMARY REPORT

Method File: /chem/msd1.1/1-20Apr95.b/TO14-0320ATGn.m  
Batch File: /chem/msd1.1/1-20Apr95.b  
Inst ID: msd1.1

ID	MDL01	MDL02	MDL03	MDL04	MDL05	MDL06	MDL07
FILENAME:	1042008	1042009	1042010	1042011	1042012	1042013	1042014
INJ. DATE:	20-APR-95	20-APR-95	20-APR-95	20-APR-95	20-APR-95	20-APR-95	20-APR-95
INJ. TIME:	13:13	13:57	14:38	15:17	16:05	16:58	17:51

Compound	MDL01	MDL02	MDL03	MDL04	MDL05	MDL06	MDL07	AVG CONC	STD DEV	MDL
1 Propylene	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
2 DICHLORODIFLUOROMETHANE	2.49	2.54	2.52	2.39	2.81	2.63	2.48	2.55	0.13	0.42
3 FREON 114	2.72	2.61	2.68	2.81	2.80	2.88	2.75	2.75	0.09	0.28
4 CHLOROMETHANE	2.53	2.56	2.87	2.68	2.51	2.52	2.67	2.62	0.13	0.41
5 VINYL CHLORIDE	2.33	2.32	2.51	2.26	2.50	2.26	2.23	2.34	0.12	0.36
6 1,3-Butadiene	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
7 BROMOMETHANE	1.92	2.06	2.05	1.96	2.12	2.12	2.08	2.05	0.08	0.25
8 CHLOROETHANE	2.40	2.43	2.19	2.16	2.37	2.28	2.25	2.30	0.10	0.33
9 TRICHLORODIFLUOROMETHANE	2.52	2.57	2.51	2.45	2.78	2.72	2.59	2.59	0.12	0.37
10 Ethanol	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
11 FREON 113	2.36	2.44	2.32	2.53	2.64	2.34	2.33	2.42	0.12	0.38
12 1,1-DICHLOROETHYLENE	2.67	2.55	2.67	2.53	2.71	2.66	2.69	2.61	0.09	0.29
13 Acetone	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
14 Carbon Disulfide	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
15 2-Propanol	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
16 Allyl chloride	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++

Reviewer 1  
Reviewer 2

Date:  
Date:

7014 MSD study for MSD-1  
Page 1

MSDL = 0.5 ppbv

e Air Toxics Ltd.  
METHOD DETECTION LIMIT SUMMARY REPORT

Method File: /chem/msd1.1/1-20Apr95.b/TO14-0320ATGn.m  
Batch File: /chem/msd1.1/1-20Apr95.b  
Inst ID: msd1.1

Compound	MDL01	MDL02	MDL03	MDL04	MDL05	MDL06	MDL07	AVG CONC	STD DEV	MDL
17 HEAVYLENE CHLORIDE	2.30	2.28	2.62	2.63	2.44	2.34	2.29	2.41	0.16	0.49
18 HIRE	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
19 trans-1,2-Dichloroethane	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
20 Acrylonitrile	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
21 Hexane	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
22 1,1-DICHLOROETHANE	2.34	2.31	2.37	2.30	2.33	2.35	2.29	2.33	0.03	0.09
23 Vinyl Acetate	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
24 Chloroprene	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
25 cis-1,2-DICHLOROETHENE	2.00	2.09	2.17	2.02	2.00	2.20	2.15	2.11	0.06	0.20
26 2-Butanone	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
27 Bromochloromethane	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	0.00	0.00
28 Tetrahydrofuran	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
29 CHLOROFORM	2.24	2.35	2.06	2.30	2.31	2.47	2.44	2.32	0.14	0.44
30 Iso-Octane	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
31 Cyclohexane	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
32 1,1,1-TRICHLOROETHANE	2.37	2.38	2.30	2.39	2.46	2.37	2.44	2.39	0.05	0.17
33 CARBON TETRACHLORIDE	2.34	2.46	2.33	2.74	2.58	2.34	2.52	2.47	0.15	0.48
34 Octafluorotoluene	48.80	45.51	44.68	43.33	46.43	46.17	48.93	46.26	2.05	6.45
35 BENZENE	2.21	2.29	2.23	2.39	2.33	2.41	2.22	2.30	0.08	0.26
36 1,2-DICHLOROETHANE	2.07	2.12	2.19	1.97	2.27	2.08	2.13	2.12	0.09	0.30
37 Heptane	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
38 1,4-Difluorobenzene	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	0.00	0.00

Reviewer 1  
Reviewer 2

Date:  
Date:

@ Air Toxics Ltd.  
METHOD DETECTION LIMIT SUMMARY REPORT

Method File: /chem/msd1.1/1-20Apr95.b/TO14-0320ATGn.m  
Batch File: /chem/msd1.1/1-20Apr95.b  
Inst ID: msd1.1

Compound	MDL01	MDL02	MDL03	MDL04	MDL05	MDL06	MDL07	AVG CONC	STD DEV	MDL
39 1-Butanol	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
40 TRICHLOROETHYLENE	2.35	2.46	2.44	2.42	2.38	2.55	2.45	2.43	0.07	0.21
41 1,2-DICHLOROPROPANE	2.29	2.35	2.41	2.33	2.41	2.47	2.41	2.38	0.06	0.19
42 1,4-dioxane	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
43 Bromodichloromethane	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
44 c-1,3-DICHLOROPROPENE	2.64	2.82	2.81	2.79	2.78	2.80	2.79	2.78	0.06	0.20
45 4-Methyl-2-pentanone	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
46 Butyl Acetate	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
47 Toluene-d8	51.97	53.54	52.25	51.89	51.31	52.01	50.96	51.99	0.82	2.57
48 TOLUENE	2.02	2.00	2.00	1.98	2.05	2.19	2.18	2.07	0.08	0.27
49 Octane	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
50 c-1,3-DICHLOROPROPENE	2.00	1.89	1.97	1.96	2.19	1.93	2.09	2.00	0.10	0.32
51 1,1,2-TRICHLOROETHANE	2.23	2.38	2.34	2.25	2.45	2.43	2.53	2.37	0.11	0.34
52 TETRACHLOROETHYLENE	2.32	2.34	2.34	2.31	2.49	2.49	2.51	2.40	0.09	0.29
53 2-Hexanone	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
54 Dibromochloromethane	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
55 1,2-DIBROMOETHANE	2.37	2.41	2.41	2.28	2.59	2.53	2.66	2.47	0.13	0.42
56 Cumene	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
57 Chlorobenzene-d5	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00	0.00	0.00
58 CHLOROBENZENE	2.24	2.35	2.17	2.19	2.35	2.35	2.46	2.30	0.10	0.33
59 ETHYL BENZENE	2.41	2.38	2.17	2.26	2.20	2.23	2.34	2.28	0.09	0.29
60 m,p-XYLENE	5.41	5.31	5.01	5.07	5.11	5.29	5.23	5.20	0.15	0.46

Reviewer 1  
Reviewer 2

Date:  
Date:

@ Air Toxics Ltd.  
METHOD DETECTION LIMIT SUMMARY REPORT

Method File: /chem/msd1.1/1-20Apr95.b/TO14-0320ATGn.m

Batch File: /chem/msd1.1/1-20Apr95.b

Inst ID: msd1.1

Compound	MDL01	MDL02	MDL03	MDL04	MDL05	MDL06	MDL07	AVG CONC	SID DEV	MDL
61 o-XYLENE	2.03	2.04	1.00	1.95	2.02	2.11	2.16	2.03	0.09	0.29
62 STYRENE	1.67	1.74	1.75	1.81	1.83	1.76	1.97	1.79	0.09	0.30
63 Bromoform	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
64 MIB	40.16	40.89	40.39	49.67	49.22	47.71	40.00	40.50	0.71	2.23
65 1,1,2,2-TETRACHLOROETH	2.52	2.65	2.52	2.62	2.87	2.81	2.81	2.68	0.14	0.44
66 4-Ethyltoluene	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
67 1,3,5-TRIMETHYLBENZENE	2.32	2.47	2.37	2.35	2.55	2.57	2.36	2.43	0.10	0.32
68 1,2,4-TRIMETHYLBENZENE	2.09	2.09	2.07	2.10	2.45	2.24	2.24	2.19	0.13	0.42
69 1,3-DICHLOROBENZENE	2.00	2.05	2.01	1.90	2.33	2.10	2.24	2.11	0.14	0.43
70 1,4-DICHLOROBENZENE	2.00	2.21	2.05	2.16	2.36	2.26	2.29	2.19	0.13	0.40
71 Isooctyl Alcohol	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
72 BENZYL CHLORIDE	1.39	1.34	1.55	1.30	1.79	1.40	1.54	1.49	0.16	0.49
73 1,2-DICHLOROBENZENE	2.04	2.15	1.99	2.04	2.42	2.26	2.29	2.17	0.16	0.49
74 Isooctyl Acrylate	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
75 DBCP	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
76 1,2,4-TRICHLOROBENZENE	1.24	1.35	1.10	1.27	1.64	1.29	1.45	1.35	0.16	0.49
77 HEXACHLOROCYCLOPENTADIENE	2.64	2.54	2.50	2.62	2.80	2.74	2.84	2.67	0.13	0.40
78 Dibromomethane	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
79 Methanol	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
80 Acrolein	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
81 Acetonitrile	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
82 Ethyl Acetate	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++

Reviewer 1

Date:

Reviewer 2

Date:

## Appendix E

## Scott Specialty Cases

AIR TOXIC LTD

**CERTIFICATE OF ANALYSIS**

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## Part Society Cases

**CERTIFICATE OF ANALYSIS**  
 7-18-11

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### Our Society Cases

## CERTIFICATE OF ANALYSIS

三	二	一	四	五	六	七	八	九	十	十一	十二	十三	十四	十五	十六	十七	十八	十九	二十	二十一	二十二	二十三	二十四	二十五	二十六	二十七	二十八	二十九	三十	三十一	三十二	三十三	三十四	三十五	三十六	三十七	三十八	三十九	四十	四十一	四十二	四十三	四十四	四十五	四十六	四十七	四十八	四十九	五十	五十一	五十二	五十三	五十四	五十五	五十六	五十七	五十八	五十九	六十	六十一	六十二	六十三	六十四	六十五	六十六	六十七	六十八	六十九	七十	七十一	七十二	七十三	七十四	七十五	七十六	七十七	七十八	七十九	八十	八十一	八十二	八十三	八十四	八十五	八十六	八十七	八十八	八十九	九十	九十一	九十二	九十三	九十四	九十五	九十六	九十七	九十八	九十九	一百
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Template-TO-14

## AIR TOXICS LTD.

SAMPLE NAME:

ID#: 01A

EPA METHOD TO-14 GC/MS Full Scan

Site Name: \_\_\_\_\_ Date of Collection: 11/05  
 OHS Project: \_\_\_\_\_ Date of Analysis: \_\_\_\_\_

Compound	MOL (ppbv)	Amount (ppbv)
Freon 12	0.5	Not Detected
Freon 114	0.5	Not Detected
Chloroethane	0.5	Not Detected
Vinyl Chloride	0.5	Not Detected
Bromoethane	0.5	Not Detected
Chloroethane	0.5	Not Detected
Freon 11	0.5	Not Detected
1,1-Dichloroethane	0.5	Not Detected
Freon 113	0.5	Not Detected
Methylene Chloride	0.5	Not Detected
1,1-Dichloroethane	0.5	Not Detected
cis-1,2-Dichloroethane	0.5	Not Detected
Chloroform	0.5	Not Detected
1,1,1-Trichloroethane	0.5	Not Detected
Carbon Tetrachloride	0.5	Not Detected
Benzene	0.5	Not Detected
1,2-Dichloroethane	0.5	Not Detected
Trichloroethane	0.5	Not Detected
1,2-Dichlorobenzene	0.5	Not Detected
cis-1,3-Dichlorobenzene	0.5	Not Detected
Toluene	0.5	Not Detected
trans-1,3-Dichlorobenzene	0.5	Not Detected
1,1,2-Trichloroethane	0.5	Not Detected
Tetrachloroethane	0.5	Not Detected
Ethylene Dibromide	0.5	Not Detected
Chlorobenzene	0.5	Not Detected
Ethyl Benzene	0.5	Not Detected
m,p-Xylene	0.5	Not Detected
o-Xylene	0.5	Not Detected
Styrene	0.5	Not Detected
1,1,2,2-Tetrachloroethane	0.5	Not Detected
1,3,5-Trimethylbenzene	0.5	Not Detected
1,2,4-Trimethylbenzene	0.5	Not Detected
1,3-Dichlorobenzene	0.5	Not Detected
1,4-Dichlorobenzene	0.5	Not Detected
Chlorocyclohexane	0.5	Not Detected
1,2-Dichlorobenzene	0.5	Not Detected
1,2,4-Trichlorobenzene	0.5	Not Detected
Hexachlorocyclopentadiene	0.5	Not Detected

Container Type:

Substrate: \_\_\_\_\_ % Recovery: \_\_\_\_\_ Method Limit: \_\_\_\_\_  
 Concentration: \_\_\_\_\_ 70-100%  
 Toluene: 0.5 \_\_\_\_\_ 70-100%  
 Bromodichloromethane: \_\_\_\_\_ 70-100%

## U.S. ENVIRONMENTAL PROTECTION AGENCY

CONTRACT LABORATORY PROGRAM  
Volatile Organics in Ambient Air - Canister

EPA Sample No.

## ANALYSIS DATA SHEET

Lab Name:	Contract:	SOW No.:
Lab Code:	Case No.:	SAS No.:
Lab Sample I.D.:	Date Received:	Date Analyzed:
Canister Pressure (units):	As Received:	( ) After Dilution: ( )
GC Column and I.D.:	Dilution Factor:	

CAS RN	COMPOUND	CONCENTRATION (ppbv)	9
75-01-4	Vinyl chloride		
79-01-6	Trichloroethylene		
67-66-3	Chloroform		
71-43-2	Benzene		
56-23-5	Carbon Tetrachloride		
127-18-4	Tetrachloroethylene		
75-35-4	1,1-Dichloroethene		
107-13-1	Acrylonitrile		
107-06-2	1,2-Dichloroethane		
108-90-7	Chlorobenzene		
71-55-6	1,1,1-Trichloroethane		
79-06-6	1,1,2-Trichloroethane		
79-43-5	1,1,2,2-Tetrachloroethane		
100-41-4	Ethylbenzene		
75-09-2	Methylene chloride		
120-82-1	1,2,4-Trichlorobenzene		
100-42-5	Styrene		
75-34-3	1,1-Dichloroethane		
108-88-3	Toluene		
1320-20-7	Xylenes, m- & o-		
95-47-6	Xylene, p-		



**STANDARD OPERATING PROCEDURE FOR  
NON-METHANE ORGANIC COMPOUNDS  
( EPA METHOD 18 - MODIFIED )  
for use at  
McCLELLAN AIR FORCE BASE**

Document: SOPNMOC1

Date: 05/03/96

Approved by: \_\_\_\_\_  
Garth Voigt, Laboratory Director

**1.0 SCOPE AND APPLICATION**

- 1.1 This SOP is to be used in conjunction with the basewide removal action work plan (RAWP) established for McClellan Air Force Base. The RAWP details the application of soil vapor extraction (SVE) of volatile organic compounds (VOCs) in soil.
- 1.2 Gas samples from vapor piezometer nests (VPNs), vapor wells (VWs), manifold piping (MP), catalytic oxidizer influent and effluent (COI and COE) and caustic scrubber effluent (CSE) will be collected in Tedlar bags and analyzed using this method.
- 1.3 This SOP is to be used by ONSITE laboratory personnel as a working document while performing analysis of soil gas samples by EPA Method 18 (Modified). This method is designed to determine the concentrations of various non-specific halogenated and non-halogenated hydrocarbons. Sample introduction is by direct injection. All procedures described in this SOP are based on EPA documents with some modifications related to the differences in equipment and instrumentation employed by ONSITE.
- 1.4 This SOP is intended for the use of experienced analysts, well versed in gas chromatography. It also should be used for training of technicians and chemists in the above referenced methods.

**2.0 OBJECTIVES**

- 2.1 The contaminant concentrations in the extracted soil gas are to be quantified using EPA Method 18 (Modified). The analytical results will be used by the client to evaluate the status and progress of the removal of VOCs from various strata in the vadose zone.

- 2.2 The contaminant concentrations in the influent and effluent streams of the catalytic oxidizer and the stack gases from the caustic scrubber are to be quantified using EPA Method 18 (Modified). The results will be used by the client to estimate the destruction and removal efficiency (DRE) of the emission control system.

### **3.0 HEALTH AND SAFETY CONSIDERATIONS**

- 3.1 The toxicity and carcinogenicity of chemicals used in this method has not been precisely defined. Each chemical should be treated as a potential health hazard, and exposure to these chemicals should be minimized. Stock standard gasses containing methane, and stock standard solutions containing n-dodecane should be handled in a fume hood. Personal protective equipment such as gloves and safety glasses should be worn by analysts while performing this analysis.
- 3.2 All reagents and standards used for analysis must be accompanied by manufacture's Material Safety Data Sheets upon arrival to the lab. These MSD Sheets are to be kept on file in the lab and made available to laboratory personnel. As a part of the training process analysts must make themselves familiar with the contents of MSD Sheets.
- 3.3 All compressed gas cylinders must be secured with chains or straps. Analysts must be trained in tank changing procedures.

### **4.0 SUMMARY OF METHOD**

- 4.1 This method employs direct injection as the sample introduction technique. This is performed through the introduction of the soil gas sample directly into the gas chromatograph. Gas chromatographic analysis allows the separation of these compounds and detection through the use of an Flame Ionization Detector (FID). VOC quantification is based on summation of area counts over a pre-determined retention time range, said quantification is based on standard calibration.

### **5.0 INTERFERENCES AND LIMITATIONS**

- 5.1 Methylene chloride could be a persistent contaminant in laboratory air. Methylene chloride should never be used or stored in a lab involved in method 18 analysis, even in small quantities. Elevated levels of methylene chloride in lab atmosphere might produce contaminated blanks and result in an elevated Method Quantitation Limit (MQL).
- 5.2 Freon-113 is another solvent frequently used in labs for extractions. As with Methylene Chloride, high airborne concentration of Freon-113 can produce

contaminated blanks, and result in an elevated Method Quantitation Limit (MQL).

- 5.3 Contamination by carryover can occur frequently after high-concentration samples are analyzed. Carryover usually occurs in two forms: the presence of carried-over analytes in low-level samples ran after a high-level sample and the presence of extremely wide peaks eluting mostly at the end of the chromatographic run. A study will be performed at the beginning of the project to establish the concentration level, if any, at which point carryover occurs. Samples exceeding this level will be followed by immediate clean-up action, which may include baking out the packed column. A reagent blank will be analyzed to prove that the contamination is at a level which has been previously demonstrated to have no carryover.
- 5.4 Separate sets of syringes should be used for preparation of standards and dilution of samples to prevent cross-contamination. Sample syringes should be baked at a temperature sufficient to remove any residual compounds between dilutions.

## **6.0 INSTRUMENTATION AND EQUIPMENT**

- 6.1 Gas chromatograph: Hewlett-Packard 5890 Series II with dual injection ports and a Flame Ionization Detector (FID).
  - 6.1.1 Chromatographic column:
    - 6.1.1.1 Column: 3% SP-2100 on 100/120 mesh Supelcoport ( Supelco), 6' x 1/8"
- 6.2 Detectors: FID, Hewlett - Packard, 0.018" ID jet.
- 6.3 Data acquisition system: PC-based Hewlett-Packard HP-3365 Chem Station.
- 6.4 Other equipment needed:
  - 6.6.1 A 5 ml - 50 ml Gas-Tight syringes.
  - 6.6.2 Microsyringe, 10 ul with a 0.006 in. ID needle (Hamilton 702N or equivalent).

## 7.0 REAGENTS AND STANDARDS

- 7.1 **Stock Standards:** Stock standards are purchased as certified solutions or gasses from a qualified manufacturer such as Absolute Standards, Supelco, Restec Ultra Scientific or Scott. After sealed ampules of stock solutions are opened, the contents are transferred into 1 ml screw-cap vials and are stored in a freezer for six months. A stock methane gas standard serves as the calibration standard and as the continuing calibration verification standard. It may be stored at room temperature for up to one year.
- 7.2 **Working Standards:** The stock methane standard serves as working standard without further dilution. Concentrations of working standards used for calibrations should bracket the widest linear range of the detector without compromising the sensitivity at the detection limit. Working standard solutions, such as the n-dodecane used for the retention time endpoint standard, should be stored in a freezer in screw cap or Mininert vials with minimum head space and checked frequently for degradation and evaporation. Their lifetime should not exceed 3 months. Working standard gasses may be stored at room temperature for up to one year. A low working standard of methane (LWS), and a high working standard of methane (HWS) serve for calibrations, in the following concentrations:

(LWS): 1,000 ppmv

(HWS): 10,000 ppmv

- 7.3 **QC Check Standards:** The QC check standard is comprised of a stock standard methane gas of a source different from the calibration standard source and is used as an initial calibration verification. The QC Check Standard should be stored at room temperature and the lifetime should not exceed one year.
- 7.4 **Retention Time Endpoint Standard:** Determination of the endpoint of the retention time range used for area summation is accomplished through the use of an endpoint standard. The standard used is n-dodecane at 200 ppm (in methanol).

## 8.0 INSTRUMENT SETTINGS

### 8.1 Gas Chromatographic conditions:

Helium flow rate: 20 ml/min

Make-up gas flow: 10 ml/min

Temperature program:

Initial temperature: 40 deg C, hold for 2 min

Ramp: 12 deg/min to 180 deg C

Detector Temperature: 200 deg C

Injector Temperature: 200 deg C

### 8.2 Detector Conditions

Hydrogen flow: 30 - 35 ml/min

Air flow: 350 - 400 ml/min

## 9.0 EXTERNAL STANDARD CALIBRATION

### 9.1 INITIAL CALIBRATION

9.1.1 A new five-point calibration must be established at the beginning of the project, after unacceptable continuing calibration check standards, and after significant maintenance events.

9.1.2 The lowest calibration standard must be greater than the method detection limit but at or below the method quantitation limit.

9.1.3 Dilutions of the gaseous working standard are prepared utilizing UHP helium in a 1 liter Tedlar bag. Helium is introduced using a 50 ml gas-tight syringe. Methane standard gas is removed from a pressurized lecture bottle into a 5 ml gas-tight syringe. An aliquot of the methane gas standard is added to the helium present in the Tedlar bag. All syringes should be well labeled to prevent the possibility of cross-contamination. A minimum of three levels of calibration standards are prepared at the following concentrations using the working standards referenced in section 7.2:

Amount of Methane Standard Used, ml	Amount of Helium used, ml	Concentration ppmv
--	------------------------------	-----------------------

1.0 (LWS)	999.0	1.0
N/A (LWS)	undiluted	1,000
N/A (HWS)	undiluted	10,000

- 9.1.4 An aliquot of the contents of the Tedlar bag, (if a diluted working standard), or the contents of a gas-tight syringe, (if an undiluted working standard), is injected directly into the gas chromatograph at the injection port.
- 9.1.5 As soon as possible after the injection, data acquisition, and the gas chromatograph temperature program should be initiated by pushing the start button on the gas chromatograph.
- 9.1.6 Response (calibration) factors are calculated for the methane standard by the computer using the following formula:

$$RF = \frac{\text{Conc. (ppmv) methane injected}^*}{\text{Total Methane Peak Area}}$$

\* 2 ml standard injection is used for standards and samples.  
Concentrations are relative to this amount.

The Relative Standard Deviation (%RSD) of the calibration factors over the working range should not exceed 20%. If linear regression is used, the correlation coefficient (r) must be greater than or equal to 0.990. If the acceptability criteria is not met, the cause must be identified and fixed immediately and the calibration must be repeated. No samples will be analyzed until the detector system is properly calibrated.

- 9.1.7 The validity of the five-point calibration curve must be verified by analyzing the QC Check Standard which is from a different source, at the mid-range calibration level. If the response for analytes of interest varies from the predicted response by more than 30%, a new calibration curve must be prepared for these analytes. The variation is calculated as a Percent Difference (PD):

$$\text{Percent Difference} = \frac{R1 - R2}{R1} \times 100,$$

where: R1 is Response Factor from a multi -point calibration and R2 is Response Factor from the QC Check Standard.

## 9.2 CONTINUING CALIBRATION

- 9.2.1 The working calibration curve must be verified at the beginning of each day, after every 10 samples, at the end of the day and after any system adjustments. This verification is performed by analyzing the midrange working standard (1000 ppmv). The percent difference is calculated for the standard and should meet the 30% PD acceptability criteria.
- 9.2.2 If the PD for the calibration check at the beginning of the day is unacceptable, a second calibration check is analyzed. If the second check fails, corrective action is required before analysis can begin. A new three-point calibration curve may need to be generated.
- 9.2.3 If a calibration check within the analytical sequence is unacceptable, all samples since the last acceptable check standard must be flagged "Q" to designate uncertainty in quantitation or identification. Non-detect results for analytes with low check standard recoveries must be rejected as potential false negatives. The URS chemist will decide if reanalysis or resampling is appropriate. A corrective action must be performed before continuing with the analysis.

## 10.0 SAMPLE RECEIPT AND ANALYSIS

- 10.1 Upon sample receipt the Chain of Custody (COC) will be checked for completeness and accuracy. Any discrepancies will be noted and the COC will be returned to the originator for correction. The physical condition of the samples will be noted on the COC. Once received, Onsite personnel will be responsible for the care and custody of the samples. The maximum holding time for soil gas samples is 24 hours, and preliminary results are expected in the field within this time.
- 10.2 Gas samples received by ONSITE Environmental Laboratories for analysis are logged into a Sample Control Book. Each sample is given a unique laboratory ID which allows it to be tracked through all laboratory procedures. The lab ID and/or client ID is listed on computer-generated reports of analysis.
- 10.3 Volatile samples are introduced into the gas chromatograph using the direct injection technique. A 2 ml aliquot of the sample is obtained in a 5 ml gas-tight

syringe equipped with a Mininert valve. The contents of the syringe are then injected into the injection port of the gas chromatograph and analyzed. A smaller volume of sample is used if a high field PID reading is noted on the COC. These PID readings will be critical in reducing the number of dilution reanalyses and improving analytical turnaround time.

- 10.4 Concentrations of NMOC analytes in air are calculated by comparison of the sum of the area counts generated over the specified retention time, to those produced by the methane standard at a known concentration.

$$\text{Conc (ppmv)} = \text{Total Area Counts (sample)} \times \text{RF (methane)} \times \text{dilution factor}$$

RF (methane) is defined in section 9.1.6, above  
dilution factor = 2/sample volume injected (mls)

- 10.4.1 Total area counts (sample) is a summation of all the area counts within the retention time period established on one side by the end of the methane calibration standard, and on the other by the end of the n-dodecane end point standard.

## 11.0 QUALITY CONTROL

### 11.1 Method Blanks

After the initial daily calibration check, a method blank (inert UHP helium from a Tedlar bag) is analyzed to show that the system is free of contaminants. A blank, which shows target analyte contamination at less than the detection limit is considered clean. Several blanks may have to be analyzed before they prove to be free of target analytes or meet the above-mentioned criteria. Blanks are also run after samples with levels of contamination that have proven to lead to carryover and false positives.

### 11.2 Laboratory Duplicates

Duplicate samples are analyzed as a part of the QC procedures to assess precision. The frequency at which duplicate samples are analyzed is 1 in 20 or 1 per day, whichever is more frequent. Samples selected as duplicates should contain analytes of interest within the calibration range. If the Relative Percent Difference (%RPD) exceeds 30%, a third aliquot of the sample is analyzed and all three are evaluated to determine the need for corrective action.

### 11.3 Retention Time End Point Standard



The retention time end point standard is analyzed to assess the stability of the retention time window, and to determine the end point for summation of the sample area counts. A retention time end point standard is analyzed at the initiation of the analytical run. If samples analytes are detected at a later retention time during the run, a second standard will be analyzed at the conclusion of the analytical run.

**11.4 Audit samples**

Laboratory audit samples, performance evaluation samples and field duplicates will be prepared and submitted by the client or an independent source. If the analysis indicates a percent difference of more than 30% for any analyte, a second aliquot of the audit sample will be analyzed. If the second check also fails to meet the criteria, corrective action must be taken to identify and correct the problem.

**11.5 Method Detection Limit Study**

A Method Detection Limit (MDL) study will be performed at the beginning of the project and after major maintenance work is performed on the instrument. The MDL study will be performed on a matrix provided by the client. This study will confirm, or, if necessary, modify the achievable MQLs listed in Appendix I. Seven replicates of a standard at 3-5 times the estimated detection limits will be taken through all the preparation and analytical steps. The MDLs will be calculated as  $3.14s$ , where  $s$  is the standard deviation of the seven measurements. The MDL study must be reviewed and approved by the URS project chemist and the Project Management Team.

**11.6 Reporting Limits**

Analytical results will be reported down to a MQL which is typically 2-5 times greater than the MDLs. Samples which require dilutions are reported with elevated MQLs. The lowest dilution possible will be performed which will still allow quantitation within the calibration range. Results between the MDLs and MQLs will be reported and flagged "J".

**11.7 Corrective Actions**

The corrective action process is initiated when data quality problems are observed or suspected. These cases include LCS recovery falling out of the acceptability limits, lack of stability during the calibration process, contamination of laboratory blanks, carryover, exceeded sample holding time, etc. Corrective actions may include reanalysis, calculation checks, recalibration, dilution or flagging the data as "estimated concentration". A Corrective Action Report (CAR) is filled out for all out of control events (Appendix III). The Laboratory Manager is responsible for correcting all problems and for documenting where and when the event occurred and was corrected and verifying that the corrective action was appropriate and sufficient. The CAR is kept in the project file.

**11.8 Retention Time Window Studies and Daily Check**

A retention time window study is used for proper chromatographic identification of analytes. It is performed at the beginning of the project and after major maintenance work is performed on the instrument. A copy of the retention window study form is attached (Appendix IV). In addition, a daily retention window check is performed. The form is completed daily by the analyst and filed with the daily QC package. A copy of the daily retention window check form is attached (Appendix V).

11.8.1 Before establishing windows, make sure the GC system is within optimum operating conditions. Make three injections of all single component standard mixtures throughout the course of a 72 hour period. Serial injections over less than a 72 hour period result in retention time windows that are too tight. The injections must be made in the same time period of each day.

11.8.2 Calculate the standard deviation of the three absolute retention times for each single component standard. If the standard deviation is zero, the laboratory will substitute the standard deviation of a close eluting, similar compound to develop a valid retention time. The daily retention time window acceptance criteria will be based on corrected retention times. This is performed through the HPChem software by the use of reference peaks.

## **12.0 DATA REVIEW AND REPORT GENERATION**

12.1 Initial data reduction is performed in the field by the Laboratory Manager and analytical results are delivered to the client as a preliminary report. The Laboratory Manager evaluates the QC criteria and initiates Corrective Action, if needed. The Laboratory Manager consults with the Laboratory Director on all QA/QC related problems encountered in the course of field work. All raw data including associated QC undergoes secondary review and validation. The fully reviewed final report and data diskette is issued to the client within seven working days of sample receipt. An example of the final report is included in Appendix VI.

12.2 Preliminary Data Report - A preliminary analytical data form or report must be completed and submitted within 24 hours of sample receipt. The information reported for each sample includes:

- a. Sample ID;
- b. Date analyzed;
- c. Analyst initials;
- d. Sample results for all calibrated analytes and unknowns in ppmv;
- e. Dilution factor for each sample;

- f. All system blank results in ppmv;
- g. RPD for each duplicate analysis;
- h. Data flags and narrative as needed to address quality control problems and presence of interferences and unknowns.

12.3 Final Data Report - Complete fully-reviewed analytical reports, including diskette deliverable (refer to contract Attachment D) must be submitted seven working days after the sample is received. All chromatograms and calibrations must be organized, stored in files and available for QA review at any time. Onsite will use the photocopier at the URS office and discuss the daily occurrences with the project chemist. All reports and supporting documents will be provided to URS at the end of the investigation. All records of analysis and calculations must be legible and sufficient to recalculate all sample concentrations. The following must be included in submittal of all hard copy report deliverables:

- a. All methods used for sample preparation through analysis;
- b. All calibrations;
- c. All raw data (analysis and reanalysis, undiluted and diluted sample data) and reduced data for field and lab QC samples;
- d. All instrument detection limits (IDLs) and calculated method detection limits (MDLs);
- e. All QA/QC data presented in summary form and all data reduction procedures;
- f. Bench records;
- g. Tabulated order of calibration standards, verification and control standards, samples, blanks, spikes, etc.;
- h. Concentration or absorbance readouts and copies of worksheets used to calculate the results;
- i. Photocopies of instrument readouts, i.e., stripcharts, printer tapes, etc.;
- j. Identify all QC reference samples, or any other reference sample or initial calibration verification, as to source, lot number, and sample number. Corresponding "true" or target values and associated 95% confidence limits for analysis results must be provided for all reference samples used.

12.3.1 Submit a narrative summary of all procedures actually used for sample preparation, cleanup, and analysis, including:

- a. Specific identification of all instruments used;
- b. Discussion of all factors affecting the analysis and all corrective actions taken;
- c. Justification for dilution(s) of all samples;

**STANDARD OPERATING PROCEDURE FOR HALOGENATED  
VOLATILE ORGANICS AND AROMATIC VOLATILE ORGANICS  
(EPA METHOD 8021)**

**for use at  
McCLELLAN AIR FORCE BASE**

Document: SOPMAFB  
Revision: 4  
Date: 10/18/96

Approved by: \_\_\_\_\_  
Garth D. Voigt, Laboratory Director

**1.0 SCOPE AND APPLICATION**

- 1.1 This SOP is to be used in conjunction with the basewide removal action work plan (RAWP) established for McClellan Air Force Base. The RAWP details the application of soil vapor extraction (SVE) of volatile organic compounds (VOCs) in soil.
- 1.2 Gas samples from vapor piezometer nests (VPNs), vapor wells (VWs), manifold piping (MP), catalytic oxidizer influent and effluent (COI and COE) and caustic scrubber effluent (CSE) will be collected in Tedlar bags and analyzed using this method.
- 1.3 This SOP is to be used by ONSITE laboratory personnel as a working document while performing analysis of soil gas samples by EPA Method 8021. This method is designed to determine the concentrations of various halogenated and aromatic organic compounds listed in Appendix I. The sample introduction technique specified for these compounds is purge and trap (EPA 5030). All procedures described in this SOP are based on EPA documents with some modifications related to the differences in equipment and instrumentation employed by ONSITE.
- 1.4 This SOP is intended for the use of experienced analysts, well versed in chromatography and purge and trap techniques. It also should be used for training of technicians and chemists in the above referenced methods.

**2.0 OBJECTIVES**

- 2.1 The contaminant concentrations in the extracted soil gas are to be quantified using EPA Method 8021. The analytical results will be used by the client to evaluate the status and progress of the removal of VOCs from various strata in the vadose zone.

- 2.2 The contaminant concentrations in the influent and effluent streams of the catalytic oxidizer and the stack gases from the caustic scrubber are to be quantified using EPA Method 8021. The results will be used by the client to estimate the destruction and removal efficiency (DRE) of the emission control system.

### **3.0 HEALTH AND SAFETY CONSIDERATIONS**

- 3.1 The toxicity and carcinogenicity of chemicals used in this method has not been precisely defined. Each chemical should be treated as a potential health hazard, and exposure to these chemicals should be minimized. The following analytes have been tentatively classified as known or suspected carcinogens: benzene, carbon tetrachloride, 1,4-dichlorobenzene, 1,2-dichloroethane, hexachlorobutadiene, 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, chloroform, 1,2-dibromoethane, tetrachloroethene, trichloroethene, and vinyl chloride. Stock standard solutions containing these compounds should be handled in a fume hood. Personal protective equipment such as gloves and safety glasses should be worn by analysts while performing this analysis.
- 3.2 All reagents and standards used for analysis must be accompanied by manufacture's Material Safety Data Sheets upon arrival to the lab. These MSD Sheets are to be kept on file in the lab and made available to laboratory personnel. As a part of the training process analysts must make themselves familiar with the contents of MSD Sheets.
- 3.3 All compressed gases cylinders must be secured with chains or straps. Analysts must be trained in tank changing procedures.

### **4.0 SUMMARY OF METHOD**

- 4.1 This method utilizes the purge and trap process as the sample introduction technique (EPA method 5030). This is performed through the introduction of the soil gas sample into a stream of purged helium, followed by collection of the halogenated and aromatic volatile organics in a sorbent trap at ambient temperature. After the purge cycle is completed, the trap is heated and backflushed, desorbing all trapped compounds into a GC column. Gas chromatographic analysis allow separation of these compounds and detection through the use of an Electrolytic Conductivity Detector (ELCD) and Photo Ionization Detector (PID). VOC identification is based on retention time data, and quantification is based on standard calibration after recoveries are standardized through the use of an internal standard.

## 5.0 INTERFERENCES AND LIMITATIONS

- 5.1 Methylene chloride, which is a target compound, could be a persistent contaminant in laboratory air. Methylene chloride should never be used or stored in a lab involved in 8021 analysis, even in small quantities. Elevated levels of methylene chloride in lab atmosphere might produce contaminated blanks and result in an elevated Method Quantitation Limits (MQLs).
- 5.2 Freon-113 is another solvent frequently used in labs for extractions. Though it is not an 8021 list target compound, it is a compound of interest for this project. In addition, high airborne concentration of Freon-113 can obscure other target analytes. Freon-113 and 1,1-Dichloroethene (1,1-DCE) coelute on the DB-624 column for all temperature conditions. Therefore, the PID detector will be calibrated for 1,1-DCE and the values obtained for the PID and ELCD detectors will be compared. The difference in values will represent the value for Freon-113.
- 5.3 Contamination by carryover can occur frequently with purge and trap systems after high-concentration samples are analyzed. Carryover usually occurs in two forms: the presence of carried-over analytes in low-level samples run after a high-level sample and the presence of extremely wide peaks eluting mostly at the end of the chromatographic run. A carryover study performed at the beginning of this project has established that a concentration level in excess of five times the high quantitation limit for each analyte respectively, is the minimum point at which carryover occurs. Samples exceeding this level will be followed by immediate clean-up action, which may include bake-out and solvent flushing of the purge and trap system as well as column baking. A reagent blank will be analyzed to prove that the contamination is at a level which has been previously demonstrated to have no carryover.
- 5.4 Separate sets of syringes should be used for preparation of standards and dilution of samples to prevent cross-contamination. Sample syringes should be triple-rinsed with methanol between dilutions

## 6.0 INSTRUMENTATION AND EQUIPMENT

- 6.1 Gas chromatograph: Hewlett-Packard 5890 Series II with dual injection ports and a Electrolytic Conductivity and Photo ionization Detector in tandem.
  - 6.1.1 Chromatographic column:
    - 6.1.1.1 Column 1: DB-624 (J&W Scientific), 75 m x 0.53 mm ID x 2

- 6.2 Detectors: ELCD/PID tandem combination, OI Analytical, model # 5200, 10.0 eV lamp.
- 6.3 Sample concentrator: OI Analytical model 4560.
- 6.4 Autosampler: OI Analytical DPM-16 Multiple Purging Module.
- 6.5 Data acquisition system: PC-based Hewlett-Packard HP-3365 Chem Station.
- 6.6 Other equipment needed:
  - 6.6.1 A 5ml or 50ml Luerlock syringe.
  - 6.6.2 Microsyringes, 10-1000 ul with a 0.006 in. ID needle (Hamilton 702N or equivalent).
  - 6.6.3 Screw-cap 1 ml vials or 2 ml vials with Mininert valves.
  - 6.6.4 Analytical balance ( 0.0001g) or top loading scale (0.01g)

## 7.0 REAGENTS AND STANDARDS

- 7.1 **Reagent grade water:** Water will be certified high purity, organic free, and will be analyzed by ONSITE to show that it is free of interferences and therefore can be used for sample dilutions and as a lab blank.
- 7.2 **Methanol:** Purge and Trap grade, Burdick and Jackson.
- 7.3 **Stock Standards:** Stock standards are purchased as certified gaseous solutions from a qualified manufacturer such as Scott Specialty Gasses. The gas standards are purchased in gas cylinders. If liquid standards are used, the following steps are followed: After sealed ampoules of stock solutions are opened, the contents are transferred into 1 ml screw-cap vials and are stored in a freezer for six months. For preparation of working standards solutions (secondary dilution standards) stock standards are removed from the freezer and are allowed to acquire room temperature before dilutions are made. Stock standards purchased from two different sources serve as a calibration standard and as a QC check standard spiking solution. Gas standards may also be used for the QC check standard spiking solution.

- 7.4 **Working Standards:** Working standards are prepared from stock standards by methanolic dilutions in 1ml screw-cap vials. Concentrations of working standards used for calibrations should bracket the widest linear range of both detectors without compromising the sensitivity at the detection limit ( the linear range of the PID is expected to deteriorate as the lamp gets older). Working standards should be stored in a freezer in screw cap or Mininert vials with minimum head space and checked frequently for degradation and evaporation. Their lifetime should not exceed 3 months. Low-level and high-level Working Standard Solutions (LWS, HWS) are prepared in 1ml of methanol at the following concentrations of analytes:

Halogenated Hydrocarbons: 1.0 ug/ml (LWS) and 10 ug/ml (HWS)

Vinyl chloride: 4.0 ug/ml (LWS) and 20 ug/ml (HWS)

Aromatic Hydrocarbons: 4.0 ug/ml (LWS) and 100 ug/ml (HWS)

When dilutions of a gaseous standard are required for calibration, they may be prepared in either of two ways. A lower volume of standard may be used in relation to a standard injection volume to provide the dilution, or a volume of gaseous standard may be combined with UHP Helium in a Tedlar bag, and a standard volume of the resultant dilution used for the calibration.

- 7.5 **QC Check Standards:** The QC Check Standard is prepared from a stock solution of a source different from the calibration standard source and is used as an initial calibration verification and as the Laboratory Control Sample (LCS) spiking solution. The QC Check Standard should be stored in a freezer in screw cap or Mininert vials with a minimum head space and checked frequently for degradation or evaporation. Their lifetime should not exceed three months. The QC Check Standard Solution is prepared in 1 ml of methanol at the same concentrations as the High-level Working Solution (See Section 7.4). As an alternative, a gas standard prepared by a qualified manufacturer may be used as the QC Check Standard.
- 7.6 **Surrogate and Internal Standards:** Compounds which are not usually found in environmental samples will be added to all samples, standards, blanks and spikes in order to monitor the effectiveness of the method and the performance of the analytical system (see Appendix II). These compounds should have a good response on both detectors and should not chromatographically interfere with the target analytes. The number of surrogate and internal standard compounds used may be reduced if the sample load is expected to be greater than 15 samples per day. 5 ul of the working surrogate/internal standard solution will be spiked directly into the 5 ml syringe with every sample or reference material.



## **8.0 INSTRUMENT SETTINGS**

### **8.1 Gas Chromatographic conditions:**

Helium flow rate: 10 ml/min  
Make-up gas flow: 20 ml/min  
Temperature program:  
Initial temperature: 40 deg C, hold for 10 min  
Ramp: 10 deg/min to 180 deg C  
Detector Temperature: 200 deg C  
Injector Temperature: 200 deg C

### **8.2 Detector Conditions**

ELCD temperature: 900 deg C  
ELCD hydrogen flow: 100 ml/min  
N-propanol flow: 20-25 ul/min  
ELCD setting: high sensitivity hydrogen mode  
PID power: 40%

### **8.3 Purge and Trap System Conditions:**

Purge gas flow: He at 40 ml/min  
Purge time: 11 min  
Trap temperature in purge mode: 30 deg C  
Dry purge time: 0 min  
Desorb time: 2 min  
Desorb temperature: 190 deg C  
Bake time: 8 min  
Bake temperature: 190 deg C  
Trap: OI Analytical trap #9 ( Tenax/ Silica gel/ Charcoal ) or #11 (carbosieve)  
Valve temperature: 120 deg C  
Transfer line temperature: 100 deg C

## **9.0 EXTERNAL STANDARD CALIBRATION**

### **9.1 INITIAL CALIBRATION**

- 9.1.1 A new three-point calibration must be established at the beginning of the project, after unacceptable continuing calibration check standards, and after significant maintenance events.
- 9.1.2 The lowest calibration standard must be greater than the method detection limit. For halogenated compounds detected by the ELCD, the concentration of the low point standard used for calibration is 20ppbv,

while the RLs for these compounds range from 3ppbv to 4ppbv. For aromatic compounds detected by the PID, the concentration of the low point standard used for calibration is 100ppbv. The RLs for the aromatic compounds range from 20ppbv to 25ppbv, with the exception of XYLMP which is 50ppbv because it is a sum of two unresolved analytes. One exception to this is that the concentration of the low point standard for DCE11, which is sometimes detected by the PID, is also 20ppbv. The RLs for DCE11 and FC113 are set higher than other halogenated compounds because recoveries are sometimes determined by difference.

- 9.1.3 An aqueous standard is prepared in a 5 ml Luerlock syringe which is first filled with reagent grade water. The plunger of the syringe is then pulled back about 1cm and surrogate standard is injected into the syringe through the Luer tip using a Hamilton microsyringe. An aliquot of a calibration standard is added to the water in a similar fashion. All microsyringes should be well labeled to prevent cross-contamination by different standards. Three levels of calibration standards are prepared at the following concentrations using low-level or high-level Working Standard Solutions defined in Section 7.4:

	Amount of Working Standard Used, ul	Approx. Conc.* ppbv
Chloromethane (CLME):	25 (LWS)	100
	10/50 (HWS)	400/2000
1,2-Dichloroethane (DCA12):	5 (LWS)	20
	10/50 (HWS)	400/2000

The range of concentrations reflects the difference in the Working Standard concentrations of halogenated and aromatic hydrocarbons.

\* The final ppbv concentrations are approximate since they are dependent on the specific molecular weight (MW) of each analyte. An average MW of 100 g/mole and a 50ml sample volume was used for these calculations.

A gas standard may be used for calibration as an alternative to these methanolic dilutions. In this case, three calibration levels will be prepared by injecting three different volumes of a single gas standard.

- 9.1.4 The content of the syringe is loaded into the sparging vessel through the Luer valve.

- 9.1.5 After the sparge chamber is loaded, the purge and trap concentrator should be programmed for the starting and final positions and the sequence is started.
- 9.1.6 Response (calibration) factors are calculated for each component by the computer using the following formula:

$$RF = \frac{\text{Mass Injected ( in nanograms )}}{\text{Total Peak Area}}$$

The Relative Standard Deviation (%RSD) of the calibration factors over the working range should not exceed 30%. If linear regression is used, the correlation coefficient (r) must be greater than or equal to 0.990. If the acceptability criteria is not met, the cause must be identified and fixed immediately and the calibration must be repeated. No samples will be analyzed until both detector systems are properly calibrated. (Response factors for internal standards determined in the calibration process are, by definition, equal to unity).

- 9.1.7 The validity of the six-point calibration curve must be verified by analyzing the QC Check Standard which is from a different source at the mid-range calibration level. If the response for analytes of interest varies from the predicted response by more than 30%, a new calibration curve must be prepared for these analytes. The variation is calculated as a Percent Difference (PD):

$$\text{Percent Difference} = \frac{R1 - R2}{R1} \times 100,$$

where: R1 is Response Factor from a multi -point calibration and R2 is Response Factor from the QC Check Standard.

## 9.2 CONTINUING CALIBRATION

- 9.2.1 The working calibration curve must be verified at the beginning of each day, after every 10 samples, at the end of the day and after any system adjustments. This verification is performed by analyzing the midrange working standard (250/500/2500ppbv). The percent difference is

calculated for each analyte of interest and should meet the 30% PD acceptability criteria.

- 9.2.2 If the PD for the calibration check at the beginning of the day is unacceptable, a second calibration check is analyzed. If the second check fails, corrective action is required before analysis can begin. A new three-point calibration curve may need to be generated.
- 9.2.3 If a calibration check within the analytical sequence is unacceptable, all samples since the last acceptable check standard must be flagged "Q" to designate uncertainty in quantitation or identification. Non-detect results for analytes with low check standard recoveries must be rejected as potential false negatives. The URS chemist will decide if reanalysis or resampling is appropriate. A corrective action must be performed before continuing with the analysis.

## **10.0 SAMPLE RECEIPT AND ANALYSIS**

- 10.1 Upon sample receipt the Chain of Custody (COC) will be checked for completeness and accuracy. Any discrepancies will be noted and the COC will be returned to the originator for correction. The physical condition of the samples will be noted on the COC. Once received, Onsite personnel will be responsible for the care and custody of the samples. The maximum holding time for soil gas samples is 24 hours, and preliminary results are expected in field within 24 hours.
- 10.2 Gas samples received by ONSITE Environmental Laboratories for analysis are logged into a Sample Control Book. Each sample is given a unique laboratory ID which allows it to be tracked through all laboratory procedures. The lab ID and/or client ID is listed on computer-generated reports of analysis.
- 10.3 Volatile samples are introduced into the gas chromatograph using the purge and trap technique ( EPA Method 5030). A 5 ml Luerlock syringe is filled with reagent grade water to overflowing, the volume of water is adjusted to 5 ml and spiked with 5 ul of the surrogate/internal standard solution. The water is transferred into a sparging vessel. A 50ml aliquot of air or soil gas sample is transferred from the Tedlar bag with a syringe with a Mininert valve. The syringe is then connected to the valve on the sparging vessel and the sample air is slowly introduced into the vessel and analyzed. A smaller volume of sample is used if a high field PID reading is noted on the COC. These PID readings will be critical in reducing the number of dilution reanalyses and improving analytical turnaround time.

- 10.4 Concentrations of analytes in air are calculated according to the following equation:

$$\text{Conc, ppbv} = \frac{\text{ng}}{\text{mls}} \times \frac{24,000}{\text{MW}}$$

mls = volume of sample injected

MW = molecular weight of the analyte

- 10.5 Unknown peaks, when requested by URS, will be quantitated using the nearest calibrated analyte and will be included on the analytical report. Unknown peaks will be reported at or above 50 ppbv for halogenated hydrocarbons and 200 ppbv for aromatic hydrocarbons (dilution factor dependent). Any fuel patterns will also be noted with a general observation of the concentration level (low, medium or high), when requested.

## 11.0 QUALITY CONTROL

### 11.1 Surrogates and Internal Standards

All samples and reference materials are to be analyzed with surrogate and internal standards. The surrogate standard is used primarily as a retention time marker in cases when retention times shift takes place. Samples are re-analyzed if the surrogate or internal standard recoveries should fall outside acceptance criteria. This criteria will be established based on the procedure described in EPA Method 8000 before sample analysis begins.

### 11.2 Method Blanks

After the initial daily calibration check, a method blank (inert UHP helium from a Tedlar bag purged in reagent grade water) is analyzed to show that the system and laboratory reagent grade water are free of contaminants. A blank, which shows target analyte contamination at less than the detection limit is considered clean. Several blanks may have to be analyzed before they prove to be free of target analytes or meet the above-mentioned criteria. Blanks are also run after samples with levels of contamination that have proven to lead to carryover and false positives.

### 11.3 Laboratory Control Sample

An LCS is analyzed by injecting a known volume of a second source standard into a Tedlar bag filled with UHP helium. The concentration is the same as the midrange calibration standard. The LCS is analyzed daily or at a frequency of 1 for each batch of up to 20 samples, whichever is more frequent. All spike recoveries must meet the 70-130% acceptance criteria or corrective actions are required.

**11.4 Laboratory Duplicates**

Duplicate samples are analyzed as a part of the QC procedures to access precision. The frequency at which duplicate samples are analyzed is 1 in 20 or 1 per day, whichever is more frequent. At least half of the samples selected as duplicates should contain analytes of interest within the calibration range. If the Relative Percent Difference (%RPD) exceeds 30%, a third aliquot of the sample is analyzed and all three are evaluated to determine the need for corrective action.

**11.5 Audit samples**

Laboratory audit samples, performance evaluation samples and field duplicates will be prepared and submitted by the client or an independent source. If the analysis indicates a percent difference of more than 35% from the true value for any analyte, a second aliquot of the audit sample will be analyzed. If the second check also fails to meet the criteria, corrective action must be taken to identify and correct the problem.

**11.6 Method Detection Limit Study**

A Method Detection Limit (MDL) study will be performed at the beginning of the project and after major maintenance work is performed on the instrument. The MDL study will be performed on a matrix provided by the client. This study will confirm, or, if necessary, modify the achievable RLs listed in Appendix I. Seven replicates of a standard at 3-5 times the estimated detection limits will be taken through all the preparation and analytical steps. The MDLs will be calculated as  $3.14s$ , where  $s$  is the standard deviation of the seven measurements. The MDL study must be reviewed and approved by the URS project chemist and the Project Management Team.

**11.7 Reporting Limits**

Analytical results will be reported down to a RL which is typically 2-5 times greater than the MDLs. Samples which require dilutions are reported with elevated RLs. The lowest dilution possible will be performed which will still allow quantitation within the calibration range.

**11.8 Corrective Actions**

The corrective action process is initiated when data quality problems are observed or suspected. These cases include LCS recovery falling out of the acceptability limits, lack of stability during the calibration process, contamination of laboratory blanks, carryover, exceeded sample holding time, etc. Corrective actions may include reanalysis, calculation checks, recalibration, dilution or

flagging the data as "estimated concentration". A Corrective Action Report (CAR) is filled out for all out of control events (Appendix III). The Laboratory Manager is responsible for correcting all problems and for documenting where and when the event occurred and was corrected and verifying that the corrective action was appropriate and sufficient. The CAR is kept in the project file.

#### **11.9 Retention Time Window Studies and Daily Check**

A retention time window study is used for proper chromatographic identification of analytes. It is performed at the beginning of the project and after major maintenance work is performed on the instrument. A copy of the retention window study form is attached (Appendix IV). In addition, a daily retention window check is performed. The form is completed daily by the analyst and filed with the daily QC package. A copy of the daily retention window check form is attached (Appendix V).

11.9.1 Before establishing windows, make sure the GC system is within optimum operating conditions. Make three injections of all single component standard mixtures throughout the course of a 72 hour period. Serial injections over less than a 72 hour period result in retention time windows that are too tight. The injections must be made in the same time period of each day.

11.9.2 Calculate the standard deviation of the three absolute retention times for each single component standard. If the standard deviation is zero, the laboratory will substitute the standard deviation of a close eluting, similar compound to develop a valid retention time. The daily retention time window acceptance criteria will be based on corrected retention times. This is performed through the HPChem software by the use of reference peaks.

#### **12.0 DATA REVIEW AND REPORT GENERATION**

12.1 Initial data reduction is performed in the field by the Laboratory Manager and analytical results are delivered to the client as a preliminary report. The Laboratory Manager evaluates the QC criteria and initiates Corrective Action, if needed. The Laboratory Manager consults with the Laboratory Director on all QA/QC related problems encountered in the course of field work. All raw data including associated QC undergoes secondary review and validation. The fully reviewed final report and data diskette is issued to the client within fourteen days of sample receipt. An example of the final report is included in Appendix VI.

12.2 Preliminary Data Report - A preliminary analytical data form or report must be completed and submitted within 24 hours of sample receipt. The information reported for each sample includes:

- a. Sample ID;
- b. Date analyzed;
- c. Analyst initials;
- d. Sample results for all calibrated analytes and unknowns in ppbv;
- e. Dilution factor for each sample;
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- g. RPD for each duplicate analysis;
- h. Data flags and narrative as needed to address quality control problems and presence of interferences and unknowns.

12.3 Final Data Report - Complete fully-reviewed analytical reports, including diskette deliverable (refer to contract Attachment D) must be submitted fourteen days after the sample is received. All chromatograms and calibrations must be organized, stored in files at the Onsite trailer and available for QA review at any time. Onsite will use the photocopier at the URS office and discuss the daily occurrences with the project chemist. All reports and supporting documents will be provided to URS at the end of the investigation. All records of analysis and calculations must be legible and sufficient to recalculate all sample concentrations. The following must be included in submittal of all hard copy report deliverables:

- a. All methods used for sample preparation through analysis;
- b. All calibrations;
- c. All reporting limits (RLs);
- d. All QA/QC data presented in summary form and all data reduction procedures;
- e. Bench records;
- f. Tabulated order of calibration standards, verification and control standards, samples, blanks, spikes, etc.;
- g. Concentration or absorbance readouts and copies of worksheets used to calculate the results;
- h. Identify all QC reference samples, or any other reference sample or initial calibration verification, as to source, lot number, and sample number. Corresponding "true" or target values and associated 95% confidence limits for analysis results must be provided for all reference samples used.



12.3.1 Submit a narrative summary of all procedures actually used for sample preparation, cleanup, and analysis, including:

- a. Specific identification of all instruments used;
- b. Discussion of all factors affecting the analysis and all corrective actions taken;
- c. Justification for dilution(s) of all samples;
- d. A summary of the source and reasons for variance from this request (e.g., method changes) including phone log communications;
- e. Report of inconsistencies and/or problems with paperwork, shipping and packaging of samples.

12.3.2 Submit a copy of the client request form and any record of communication, generated during the analysis of these samples, between the lab and URS. This is considered a deliverable item. If not included in the data package(s), the data package(s) will be considered incomplete.

12.3.3 Submit an SDG notification form which contains the date of sampling, the date due of the preliminary report, and final report, as well as the sample identification number of each sample in the SDG. This form must also be submitted on diskette within five days of sample receipt, in electronic format compatible with the clients database.

12.4 The data diskette will be made available to the client in a format compatible with their database. The data set will be composed of a subset of the IRPIMS file in the required ASCII file submittal format.

## **13.0 REFERENCES**

- 13.1 US. EPA 40CFR Part 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; Final Rule and Interim Final Rule and Proposed Rule", October 26, 1984
- 13.2 U.S. EPA Contract Laboratory Program, Statement of Work for Organic Analysis, July 1985
- 13.3 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition, Final Update 1, Revision, July 1992
- 13.4 Test Methods for Evaluating Solid Waste, Physical and Chemical Methods, SW-846, revision 0, September 1986

California Laboratory Services  
Standard Operating Procedures

**Title:** Total Extractable Petroleum  
Hydrocarbons Extraction Procedure

**Method Number:** M8015D

**Method Type:** California Luft

**Revision Number:** M8015D\_EXT-0

**Author:** Prags Govender

**Effective Date:** May 1, 1993

**Author's Title:** Extraction Supervisor

**Department:** Extractions

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## **1.0 Scope and Application**

- 1.1 This method is used to extract waters, soils and other environmental matrices for extractable petroleum hydrocarbons. This method may be used to determine the presence of aliphatic, alicyclic and aromatic hydrocarbons in the C<sub>8</sub>-C<sub>30</sub> range. The following petroleum products have been successfully determined by this method: diesel fuel, kerosene, various jet fuels, bunker fuel, and other fuel oils; mineral spirits, paint thinner, stoddard solvent, charcoal lighter fluid and naphtha.

## **2.0 Safety Issues**

- 2.1 Proper safety procedures should be used when handling all chemicals and samples, this includes at a minimum wearing gloves, lab coat, and eye protection. See California Laboratory Services (CLS) Chemical Hygiene plan for more detailed information on safety.

## **3.0 Chain of Custody Compliance**

- 3.1 All samples removed from login must be signed out. Aliquot taken from the original samples for analysis will be accounted for by entering sample ID in the proper log books during preparation and analysis. All documentation (raw data and general reports) and samples (this includes digested samples) should be given their correct laboratory ID to assure total traceability. See CLS COC SOP for more details on sample traceability and integrity.

## **4.0 Summary of Method**

- 4.1 Petroleum hydrocarbons are extracted from environmental samples with methylene chloride (water samples) or 1:1 acetone-methylene chloride (soil and other solids). The solvent extract is then dried and concentrated prior to being analyzed on a gas chromatograph equipped with a flame ionization detector.

## **5.0 Sample Collection, Preservation, Containers, and Holding Time**

- 5.1 Water 1 Liter amber bottles, cool to 4°C, analyze within 7 days of sampling.
- 5.2 Soil, sludges, and wastes brass tube, cool 4°C, analyze within 14 days of sampling.

## **6.0 Apparatus and Materials**

- 6.1 Volumetric flasks, Class A - 10, 50, 100, 500, and 1,000 mL with a ground glass stopper.
- 6.2 Microsyringes - 10 and 25 uL with a 0.006 in. ID needle and a 100 uL.
- 6.3 Analytical balance - 0.0001 g.

## **7.0 Reagents**

- 7.1 Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.
- 7.2 Solvents: Methylene chloride, acetone, anhydrous granular sodium sulfate.
- 7.3 Spike Standard: 1000ppm spiking compounds represent the different compound groups and the different retention times.
- 7.4 Surrogate Std: 1,000 ppm solution of pentacosane is prepared if client requests. Add 100uL.

## **8.0 Interference**

- 8.1 NA

## **9.0 Procedure**

- 9.1 Sample extraction procedures are Method 3510 for water samples, and California LUFT Method for soil samples.

## 9.2 Water Samples

- 9.2.1 Place 1000mL sample in a 2L separatory funnel.
- 9.2.2 For Matrix spikes or Laboratory Control samples, spike with 1000ppm diesel.
- 9.2.3 Add 100 $\mu$ L of surrogate (1000ppm of pentacosane).
- 9.2.4 Extract with 3x 60 MeCl<sub>2</sub>
- 9.2.5 Pass thru Na<sub>2</sub>SO<sub>4</sub> into 250mL erlenmeyer flask.
- 9.2.6 Concentrate by KD to approximately 6 mLs.
- 9.2.7 Adjust final volume under N<sub>2</sub> to 2mL in MeCl<sub>2</sub>.
- 9.2.8 Submit extracts to GC in 2mL vials (1000mL/2mL).

## 9.3 Soil and Solid samples

- 9.3.1 Homogenize according to the CLS homogenizing SOP.
- 9.3.2 Weigh out 50g in a 4oz. bottle along with 20g Na<sub>2</sub>SO<sub>4</sub>.
- 9.3.3 Add 50mL 1:1 MeCl<sub>2</sub> and acetone.
- 9.3.4 If a Matrix spike or Laboratory Control sample spike with 100 $\mu$ L 10,000ppm diesel.
- 9.3.5 Add surrogate solution, pentacosane, (100  $\mu$ L of 1,000 ppm).
- 9.3.6 Put on shaker for approximately 4 hours.
- 9.3.7 Centrifuge.
- 9.3.8 Aliquot 10mL (archive the balance) and concentrate under N<sub>2</sub> to 1mL.
- 9.3.9 Submit extracts to GC in autosampler vials (10g/mL).

## 10.0 Quality Control

- 10.1 Section 10.1.1 through 10.1.5 are the General QC requirements for M8015D analysis, for detailed information on these requirements see CLS's Organic QC SOP.

- 10.1.1 A method blank (reagent water blank) shall be analyzed with each batch (the number of total samples in an QC batch should not exceed ten samples plus the number of samples required to perform QC evaluation of the ten initial samples).
- 10.1.2 At least one matrix spike (MS) and one matrix spike duplicate (MSD) will be analyzed per analytical batch.
- 10.1.3 A laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) will be processed with each analytical batch.
- 10.1.4 Analyst should monitor the performance of the extraction, cleanup (when used), and analytical system and the effectiveness of the method in dealing with each sample matrix by spiking each sample, standard, and organic-free reagent water blank with surrogates (as contract required for this test only).
- 10.1.5 Duplicates as contract required.

## **11.0 References**

- 11.1 U.S. EPA 1990e Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. SW-846, Third Edition, Office of Solid Waste and Emergency Response, Washington, DC.
- 11.2 40 CFR, Part 136. July 1, 1992. "Guidelines Establishing Test Procedures for Analysis of Pollutants Under the Clean Water Act." Vol. 40 Pt136 App A.

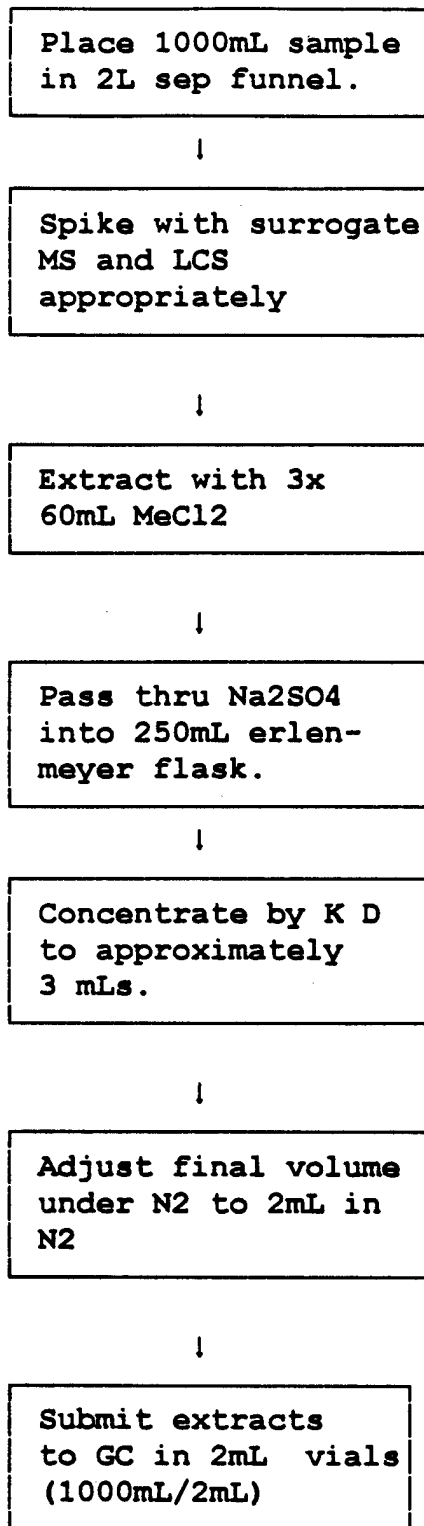


Figure 9-1 Extraction Flow Chart

Method M8015D Soil

50g soil (in 4 oz  
bottle) + 20g Na<sub>2</sub>SO<sub>4</sub>

↓

Add 50mL 1:1 MeCl<sub>2</sub>  
and Acetone

↓

Spike MS and LCS

↓

Spike with surrogate

↓

Shake for 4 hours

↓

Centrifuge

↓

Aliquot 10mL (save  
balance) and conc.  
under N<sub>2</sub> to 1mL.

↓

Submit extracts  
to GC in autosample  
vials (10g/mL)

Figure 9-2 Extraction Flow Chart

California Laboratory Services  
Standard Operating Procedures

Title: Volatile Organics by Gas  
Chromatography/Mass Spectrometry

Method Number: 8240A

Method Type: GC/MS Capillary Column  
Technique

Revision Number: 8240A-1

Author: Mark Weitemier

Effective Date: May 1, 1995

Author's Title: VOA GC/MS Chemist

Department: GC/MS

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1.0 Scope and Application

- 1.1 Method 8240 is used to determine volatile organic compounds in a variety of solid waste matrices. This method is applicable to nearly all types of samples, regardless of water content, including ground water, aqueous sludges, caustic liquors, acid liquors, waste solvents, oily wastes, mousses, tars, fibrous wastes, polymeric emulsions, filter cakes, spent carbons, spent catalysts, soils, and sediments.
- 1.2 Method 8240 can be used to quantitate most volatile organic compounds that have boiling points below 200-C and that are insoluble or slightly soluble in water. Volatile water-soluble compounds can be included in this analytical technique. However, for the more soluble compounds, quantitation limits are approximately ten times higher because of poor purging efficiency. The method is also limited to compounds that elute as sharp peaks from a GC column packed with graphitized carbon lightly coated with a carbowax. Such compounds include low molecular weight halogenated hydrocarbons, aromatics, ketones, nitriles, acetates, acrylates, ethers, and sulfides.
- 1.3 The estimated quantitation limit (EQL) of Method 8240 for an individual compound is approximately 5 ug/Kg (wet weight) for soil/sediment samples, 0.5 mg/Kg (wet weight) for wastes, and 5 ug/L for ground water. EQLs will be proportionately higher for sample extracts and samples that require dilution or reduced sample size to avoid saturation of the detector.
- 1.4 Method 8240 is based upon a purge-and-trap, gas chromatographic/mass spectrometric (GC/MS) procedure. This method is restricted to use by, or under the supervision of, analysts experienced in the use of purge-and-trap systems and gas chromatograph/mass spectrometers, and skilled in the interpretation



of mass spectra and their use as a quantitative tool.

ANALYTE:	CAS #	Purge-and-Trap	Injection
Acetone	67-64-1	pp	a
Benzene	71-43-2	a	a
Bromodichloromethane	75-27-4	a	a
Bromoform	75-25-2	a	a
Bromomethane	74-83-9	a	a
2-Butanone	78-93-3	pp	a
Carbon disulfide	75-15-0	pp	a
Carbon tetrachloride	56-23-5	a	a
Chlorobenzene	108-90-7	a	a
Chlorobenzene-d5 (I.S.)	108-90-7	a	a
Chloroethane	75-00-3	a	a
2-Chloroethyl vinyl ether	110-75-8	a	a
Chloroform	67-66-3	a	a
Chloromethane	74-87-3	a	a
Dibromochloromethane	124-48-1	pp	a
Dibromomethane	74-95-3	a	a
1,2-Dichlorobenzene	95-50-1	a	a
1,3-Dichlorobenzene	541-73-1	a	a
1,4-Dichlorobenzene	106-46-7	a	a
Dichlorodifluoromethane	75-71-8	a	a
1,1-Dichloroethane	75-34-3	a	a
1,2-Dichloroethane	107-06-2	a	a
1,2-Dichloroethane-d4 (surr.)	107-06-2	a	a
1,1-Dichloroethene	75-35-4	a	a
1,2-Dichloroethene, total	540-59-0	a	a
1,2-Dichloropropane	78-87-5	a	a
cis-1,3-Dichloropropene	10061-01-5	a	a
trans-1,3-Dichloropropene	10061-02-6	a	a
Ethylbenzene	100-41-4	a	a
2-Hexanone	591-78-6	pp	a
Methylene chloride	75-09-2	a	a
4-Methyl-2-pentanone	108-10-1	pp	a
Styrene	100-42-5	a	a
1,1,2,2-Tetrachloroethane	79-34-5	a	a
Tetrachloroethene	127-18-4	a	a
Toluene	108-88-3	a	a
Toluene-d8 (surr.)	108-88-3	a	a
1,1,1-Trichloroethane	71-55-6	a	a
1,1,2-Trichloroethane	79-00-5	a	a
Trichloroethene	79-01-6	a	a
Trichlorofluoromethane	75-69-4	a	a
1,1,2-Trichlorotrifluoroethane	79-13-1	a	a
Vinyl acetate	108-05-4	a	a
Vinyl chloride	75-01-4	a	a
Xylene (Total)	1330-20-7	a	a

a = Adequate response by this technique.  
 b = Chemical Abstract Services Registry Number.  
 pp = Poor purging efficiency resulting in high EQLs.  
 pc = Poor chromatographic behavior.

## 2.0 Safety Issues

2.1 Proper safety procedures should be used when handling all chemicals and samples, this includes at a minimum wearing gloves, lab coat, and eye protection. See California Laboratory Services (CLS) Chemical Hygeine plan for more detailed information on safety.

## 3.0 Chain of Custody Compliance

3.1 All samples removed from login must be signed out. Aliquot taken from the original samples for analysis will be accounted for by entering sample ID in the proper log books during preparation and

analysis. All documentation (raw data and general reports) and samples (this includes digested sample) should be given their correct laboratory ID to assure total traceability. See CLS COC for more details.

#### 4.0 Summary of Method

- 4.1 The volatile compounds are introduced into the gas chromatograph by the purge-and-trap method or by direct injection (in limited applications). The components are separated via the gas chromatograph and detected using a mass spectrometer, which is used to provide both qualitative and quantitative information. The chromatographic conditions, as well as typical mass spectrometer operating parameters, are given.
- 4.2 If the above sample introduction techniques are not applicable, a portion of the sample is dispersed in methanol to dissolve the volatile organic constituents. A portion of the methanolic solution is combined with organic-free reagent water in a specially designed purging chamber. It is then analyzed by purge-and-trap GC/MS following the normal water method.
- 4.3 The purge-and-trap process - An inert gas is bubbled through the solution at ambient temperature, and the volatile components are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the volatile components are trapped. After purging is completed, the sorbent column is heated and backflushed with inert gas to desorb the components onto a gas chromatographic column. The gas chromatographic column is heated to elute the components, which are detected with a mass spectrometer.

## 5.0 Sample Collection, Preservation, Containers, and Holding Time

Table 3  
Recommended Sample Containers, Preservations , and Holding Times

Parameter	Container	Preservative	Holding Time
<b>Volatile Organics</b>			
Concentrated Waste Samples	8 oz. widemouth glass with Teflon liner	None	14 days
<b>Liquid Samples</b>			
No Residual Chlorine Present	2 40ml vials with Teflon lined septum caps	4 drops conc. HCl, Cool, 4°C	14 days
Residual Chlorine Present	2 40ml vials with Teflon lined septum caps	Collect sample in a 4 oz. soil VOA container which has been preserved with 4 drops of 10% sodium thiosulfate. Gently mix sample and transfer to a 40ml VOA vial that has been pre-preserved with 4 drops conc. HCl, Cool to 4°C	14 days
Acrolein and Acrylonitrile		Adjust to pH 4-5, Cool, 4°C	14 days
Soil/Sediments and Sludges	4 oz. (120ml) widemouth glass with Teflon liner	Cool, 4°C	14 days

## 6.0 Apparatus and Materials

- 6.1 Microsyringes - 10 uL, 25 uL, 100 uL, 250 uL, 500 uL, and 1,000 uL.
- 6.2 Syringe valve - Two-way, with Luer ends (three each), if applicable to the purging device.

- 6.3 Syringe - 5 mL, gas-tight with shutoff valve.
- 6.4 Balances - Analytical, 0.0001 g, and top-loading, 0.1 g.
- 6.5 Glass scintillation vials - 20 mL, with screw caps and Teflon liners or glass culture tubes with a screw cap and Teflon liner.
- 6.6 Volumetric flasks, Class A - 10 mL and 100 mL, with ground-glass stoppers.
- 6.7 Vials - 2 mL, for GC autosampler.
- 6.8 Spatula - Stainless steel.
- 6.9 Disposable pipets - Pasteur.
- 6.10 Heater or heated oil bath - Should be capable of maintaining the purging chamber to within 1°C over the temperature range of ambient to 100°C.
- 6.11 Purge & Trap system and Gas Chromatograph/Mass Spectrometer System.
  - 6.11.1 GC - HP 5890  
MSD - HP 5970  
Data System - RTE - A, HP - 1000
  - 6.11.2 Tekmar AIS 2016|LCS 2000  
Trap - Carbopack B/Carbosieve S-III from Supelco (P/N # 2-0321).
  - 6.11.3 Column - Vocol wide bore capillary column 105m x 0.53mm I.D., 3µm film, Supelco (P/N # 2-5358) J&W 75m .053ID 3µ film

## 7.0 Reagents

- 7.1 Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination. For detailed information on the reagents and standard used by CLS see the CLS Reagent/Standard SOP.
- 7.2 Organic-free reagent water - All references to water in this method refer to organic-free reagent water.

- 7.3 Stock solutions - Stock solutions may be prepared from pure standard materials or purchased as certified solutions.
- 7.3.1 Prepare fresh standards every two months for gases. Reactive compounds such as 2-chloroethylvinyl ether and styrene may need to be prepared more frequently. All other standards must be replaced after six months. Both gas and liquid standards must be monitored closely by comparison to the initial calibration curve and by comparison to QC check standards. It may be necessary to replace the standards more frequently if either check exceeds a 25% difference.
- 7.4 Secondary dilution standards - Using stock standard solutions, prepare in methanol, secondary dilution standards containing the compounds of interest, either singly or mixed together. Secondary dilution standards must be stored with minimal headspace and should be checked frequently for signs of degradation or evaporation, especially just prior to preparing calibration standards from them. It is recommended that the secondary dilution standard should be prepared at a concentration of 25 mg/L.
- 7.5 Surrogate standard/internal standard mixture. The surrogates are Toluene-d8, 4-Bromofluorobenzene and 1,2-Dichloroethane-d4. The internal standards are bromochloromethane, 1,4-Difluorobenzene, and chlorobenzene-d5. Surrogate standard and internal standard spiking solution should be prepared from the stock at concentrations of 100µg/mL and 50µg/mL in methanol, respectively. Each sample under going GC/MS analysis must be spiked with 5µL of surrogate and internal standard mixture prior to analysis.
- 7.6 4-Bromofluorobenzene (BFB) standard - A standard solution containing 100µg/mL of BFB in methanol should be prepared.
- 7.7 Calibration standards - Calibration standards at five concentrations (25,50,100,200,300 µg/L) should be prepared from the secondary dilution of stock standards. Prepare these solutions in organic-free reagent water. One of the concentrations should be at a concentration near, but above, the method detection limit. The remaining concentrations should correspond to the expected range of concentrations found in real samples but should not exceed the working range of the GC/MS system. Each standard should contain each analyte for detection by this method.
- 7.8 Matrix spiking mixture - The matrix spiking standards are 1,1-dichloroethene, trichloroethene, chlorobenzene, toluene, and benzene. The mixture should be prepared in methanol, with each compound present at a concentration of 50µg/mL, and a 5µL of

spiking mixture is spiked into samples.

7.9 Great care must be taken to maintain the integrity of all standard solutions. It is recommended that all standards be stored in methanol at -10°C to -20°C in screw cap amber bottles with Teflon liners.

7.10 Methanol, CH<sub>3</sub>OH. Pesticide quality or equivalent. store apart from other solvents.

## 8.0 Interferences

8.1 Samples can be contaminated by diffusion of volatile organics (particularly methylene chloride and fluorocarbons) through the septum seal into the sample during shipment and storage. A trip blank, prepared from organicfree reagent water and carried through the sampling and handling protocol, can serve as a check on such contamination.

8.2 Cross contamination can occur whenever high-concentration and low concentration samples are analyzed sequentially. Whenever an unusually concentrated sample is analyzed, it should be followed by the analysis of organic-free reagent water to check for cross contamination. The purge-and-trap system may require extensive bake-out and cleaning after a high-concentration sample.

8.3 Impurities in the purge gas and from organic compounds out-gassing from the plumbing ahead of the trap account for the majority of contamination problems.

## 9.0 Procedure

9.1 Soil/sediment and Waste samples.

9.1.1 Low-concentration method - Weigh 5g or 1g sample into a purge and trap tube.

9.1.1.1 Draw up 5mL of D.I. water into a 5mL luerlok syringe. Spike 5µL of I.S. /surrogate mixture into the syringe, then put it into the sample tube on the purge and trap system. Ready for sample analysis.

9.1.2 High-Concentration method - weigh 10g or 5g sample into 40mL vial.

- 9.1.2.1 Add 10mL methanol to 40mL vial.
- 9.1.2.2 Vortex for 30 seconds.
- 9.1.2.3 Let settle or centrifuge till free of soil debris.
- 9.1.2.4 Add 10µL to 100µL methanol extract into luerlok syringe, then put sample into purge and trap tube.

9.1.2.5 Draw up 5mL D.I. water into 5mL luerlok syringe. Spike 5µL of I.S./surrogate mixture to the syringe, then add it into sample tube, total volume is 10mL. Ready for sample analysis.

9.1.2.6 For high concentration do serial dilution.

## 9.2 Water Sample

9.2.1 Put 5mL of sample into a luerlok syringe.

9.2.2 Spike 5µL I.S./surrogate into the sample, then add it into the sample tube (total volume 5mL). Ready for sample analysis.

9.3 For spike (MS, MSD, MB, LCS, and LCSD) add 5µL of spiking solution into 5mL of D.I. water with I.S./surrogate mixture into the 5mL syringe, then add into the sample tube.

9.4 The instruments are to be set up as follows:

9.4.1 GC/MS operating conditions:  
 Electron energy: 70 volts  
 Mass range: 35-300 amu  
 Scan time: 5 sec/peak

Interface Temperature 225°C

Temperature Program.

	Rate	Temp	Hold time
Initial value		45°C	7 min
	6.0°C/min	110°C	1 min

	15°C/min	220°C	7 min
Total run time	30 minutes.		
Scan start time	4.0 minutes		

9.4.2 Purge and Trap System.

Purge time: 11 min.	Dry purge time: 1.0
Desorb preheat: 225°C,	Desorb: 4 min at 250°C
Bake: 17min at 260°C,	Line Temp: 110°C
Valve Temp: 110°C	

9.5 The sequence for sample analysis is as follows:

- 1) Pass BFB Tune
- 2) 5 point initial calibration
- 3) Daily GC/MS initial calibration verification
- 4) Laboratory Control Sample and Laboratory Control Sample Dup
- 5) Method blank every 20 samples (min one per day)
- 6) 10 or less samples
- 7) Matrix spike and matrix spike duplicate

9.5.1 5 point initial calibration.

9.5.1.1 The system performance check compound (SPCC). The average RF must be calculated for each compound. A system performance check should be made before this calibration curve is used. Five compounds (the System Performance Check Compounds, or SPCCs) are checked for a minimum average response factor. These compounds are chloromethane, 1,1-dichloroethane, bromoform, 1,1,2,2-tetrachloroethane, and chlorobenzene. The minimum acceptable average RF for these compounds should be 0.300 (0.250 for bromoform). These compounds typically have RFs of 0.4-0.6 and are used to check compound instability and to check for degradation caused by contaminated lines or active sites in the system.

9.5.1.2 The calibration check compound (CCC). Using the RFs from the initial calibration, calculate the percent relative standard deviation (%RSD) for Calibration Check Compounds (CCCs). The %RSD for each individual CCC should be less than 30 percent. This criterion must be met in order for the individual calibration to be valid. The CCCs are:



1,1-Dichloroethene,  
Chloroform,  
1,2-Dichloropropane,  
Toluene,  
Ethyl benzene,  
and vinyl chloride.

9.5.2 Daily GC/MS Initial calibration verification.

- 9.5.2.1 Prior to the analysis of samples, inject or purge 50 ng of the 4-bromofluorobenzene standard. The resultant mass spectra for the BFB must meet all of the criteria given in Table 3 before sample analysis begins. These criteria must be demonstrated each 12 hour shift.
- 9.5.2.2 The initial calibration curve for each compound of interest must be checked and verified once every 12 hours of analysis time. This is accomplished by analyzing a midpoint concentration (50ppb) for the working range of the GC/MS by checking the SPCC (Section 9.5.2.3) and CCC (Section 9.5.2.4).
- 9.5.2.3 System Performance Check Compounds (SPCCs) - A system performance check must be made each 12 hours. If the SPCC criteria are met, a comparison of response factors is made for all compounds. This is the same check that is applied during the initial calibration. The minimum response factor for volatile SPCCs is 0.300 (0.250 for Bromoform).
- 9.5.2.4 Calibration Check Compounds (CCCs): After the system performance check is met, CCCs listed in Section 9.5.1.2 are used to check the validity of the initial calibration. If the percent difference for any compound is greater than 20, the laboratory should consider this a warning limit. If the percent difference for each CCC is less than 25%, the initial calibration is assumed to be valid. If the criterion is not met (> 25% difference), for any one CCC, corrective action MUST be taken.
- 9.5.2.5 The internal standard responses and retention times in the check calibration standard must be evaluated immediately after or during data acquisition. If the retention time for any internal standard changes by more than 30 seconds from the last check calibration (12 hours), the chromatographic system must be inspected for

malfunctions and corrections must be made, as required. If the EICP area for any of the internal standards changes by a factor of two (- 50% to + 100%) from the last daily calibration standard check, the mass spectrometer must be inspected for malfunctions and corrections must be made, as appropriate. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning are necessary.

9.6 Review data being aware of the following:

- 1) Check BFB Tune
- 2) Check SPCC and CCC
- 3) Check I.S.
- 4) Check surrogate recovery
- 5) Check for positive analytes
- 6) Check for retention time and mass spectra matching
- 7) Check for QC sample recovery

9.6.1 Retention time matching. The sample component RRT must compare within +/- 0.06 RRT units of the RRT of the standard component. For reference, the standard must be run within the same 12 hours as the sample.

9.6.2 Mass spectra matching. (1) All ions present in the standard mass spectra at a relative intensity greater than 10% (most abundant ion in the spectrum equals 100% must be present in the sample spectrum). (2) The relative intensities of ions specified in (1) must agree within plus or minus 20% between the standard and sample spectra. (Example: For an ion with an abundance of 50% in the standard spectra, the corresponding sample abundance must be between 30 and 70 percent.

9.6.3 Tentative identification. For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the type of analyses being conducted. Guidelines for making tentative identification are: (1) Relative intensities of major ions in the reference spectrum (ions > 10% of the most abundant ion) should be present in the sample spectrum.

(2) The relative intensities of the major ions should agree within +/- 20%. (Example: For an ion with an abundance of 50% in the standard spectrum, the corresponding sample ion abundance must be between 30 and 70%). (3) Molecular ions present in the reference spectrum should be present in the sample spectrum. (4) Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of coeluting compounds. (5) Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or coeluting peaks. Data system library reduction programs can sometimes create these discrepancies.

## 10.0 Quality Control

10.1 Section 10.1.1 through 10.1.13 are the General QC requirements for 8240 analysis.

- 10.1.1 A QC check sample containing all analytes of interest to be run once in the life of the method.
- 10.1.2 Method Detection Limit (MDL) will be posted inside the Maintenance Log for easy reference.
- 10.1.3 The GC/MS system must be tuned to meet the BFB specifications in Table 3.
- 10.1.4 There must be a 5 point initial calibration of the GC/MS system as specified in Section 9.5.1
- 10.1.5 The GC/MS system must meet the SPCC criteria specified in Section 9.5.1.1 and the CCC criteria in Section 9.5.1.2, each 12 hours.
- 10.1.6 A 5 point initial calibration with response factors that are < 30%.
- 10.1.7 A method blank (reagent water blank) shall be analyzed with each batch (the number of total samples in an QC batch should not exceed ten samples plus the number of samples required to perform QC evaluation of the ten initial samples).

- 10.1.8 At least one matrix spike (MS) and one matrix spike duplicate (MSD) will be analyzed per analytical batch.
- 10.1.9 A laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) will be processed with each analytical batch.
- 10.1.10 Analyst should monitor the performance of the extraction, cleanup (when used), and analytical system and the effectiveness of the method in dealing with each sample matrix by spiking each sample, standard, and organic-free reagent water blank with surrogates.
- 10.1.11 A trip blank as contract required.
- 10.1.12 Duplicates as contract required.

## 10.2 Corrective Action

- 10.2.1 Corrective action for out of control events is outlined in the attached Table 10.1. If detailed corrective action information is need see CLS's Organic QC SOP.

## 11.0 References

- 11.1 U.S. EPA 1990e Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. SW-846, Third Edition, Office of Solid Waste and Emergency Response, Washington, DC.
- 11.2 Federal Register, Part 100 to 149. July 1, 1992. "Guidelines Establishing Test Procedures for Analysis of Pollutants Under the Clean Water Act." Vol. 40 Pt136 App A.

Table 10-1  
SUMMARY OF QUALITY CONTROL PROCEDURES

Method	Parameter	QC Performed	Frequency	Acceptance Criteria	Correcti
Organic	QC Check Sample		1 time per life of method	Recovery must be within limits as specified in the individual methods in SW846	Correct
	Initial Calibration		Initially and as required.	$r \geq 0.995$ or $RF < 20\%$	1) Evalua 2) Reanal 3) Recali
	ICV, CCV, and FCV		Daily before, during and after sample analysis	$\pm 15\%$	1) Determ 2) Recali 3) Rerun
	Retention Time Windows		Initially updated by mid-point once/day.	$\pm 3$ times STD of the absolute retention times for each standard	1) Determ 2) Write 3) Rerun

Method blank	1 per batch.	The highest of: ≤ Detection Limit or 5% of Regulatory limit or 5% of measured concentration in the sample.	1) Determine the problem. 2) Report to supervisor. 3) Write narrative 4) Rerun if necessary
Matrix spike	1 per batch	See Matrix spike control chart data.	1) Evaluate system. 2) Check calculations. 3) Check instrument 4) Check extraction 5) If problem re-extract and re-analyze 6) Check LCS 7) If LCS is with in SW846 limits consider test under control, write narrative for MS that exceeded limits, complete analysis write up. 8) If LCS isn't with in SW846 Method limits, problem not resolved. Once LCS is within limits 1) Report to supervisor, flag data, and give probable reason for non-conformance. 2) Write narrative.
Matrix spike duplicate	1 per batch samples	See control chart data.	Same as Matrix Spike
Surrogate spikes	Every sample, method blank, and standard.	See Surrogate control chart data.	1) Check calculations If errors recalculate 2) Check instrument performance. If instrument problem, correct, reanalyze and the extract. 3) If upon re-analysis the recovery is not within limits, write narrative, report situation to supervisor, and flag data.
Laboratory Control Sample	1 per batch.	See LCS control chart data.	1) Evaluate system. 2) Check calculations. 3) Check instrument. 4) Check extraction 5) If problem re-extract and analyze. 6) Report to supervisor. 7) Write narrative.
Laboratory Control Sample Duplicate	1 per batch.	See LCS control chart data.	Same as LCS
Duplicates	As contract-required	120% or as contract specified.	Same as Matrix Spike
Trip Blanks	As contract-required	Same as method blank.	Same as method blank

### Method 8240 pre GC analysis

5g soil in VOA  
vial + 10mL MeOH  
purge and trap  
MeOH

↓

No spiking.

↓

Shake for 30 minutes

↓

Centrifuge

↓

Decant extracts into  
10mL vials (in VOA  
lab)

↓

Store extracts in  
VOA refrigerator.  
(FC : 5g/10mL)

↓

Ready for  
GC/MS Analysis

FLOW CHART

TABLE 3. BFB KEY ION ABUNDANCE CRITERIA

Mass	Ion Abundance Criteria
50	15 to 40% of mass 95
75	30 to 60% of mass 95
95	base peak, 100% relative abundance
96	5 to 9% of mass 95
173	less than 2% of mass 174
174	greater than 50% of mass 95
175	5 to 9% of mass 174
176	greater than 95% but less than 101% of mass 174
177	5 to 9% of mass 176

TABLE 4. QUANTITY OF METHANOL EXTRACT REQUIRED FOR ANALYSIS OF HIGH-CONCENTRATION SOILS/SEDIMENTS

Approximate Concentration Range	Volume of Methanol Extract
500 - 10,000 ug/Kg	100 uL
1,000 - 20,000 ug/Kg	50 uL
5,000 - 100,000 ug/Kg	10 uL
25,000 - 500,000 ug/Kg	100 uL of 1/50 dilution

Calculate appropriate dilution factor for concentrations exceeding this table.

TABLE 5. VOLATILE INTERNAL STANDARDS WITH CORRESPONDING ANALYTES ASSIGNED  
FOR QUANTITATION

Bromochloromethane

1.4-Difluorobenzene

-----  
Acetone

-----  
Benzene

Acrolein

Bromodichloromethane

Acrylonitrile

Bromoform

Bromomethane

2-Butanone

Carbon disulfide

Carbon tetrachloride

Chloroethane

Chlorodibromomethane

Chloroform

2-Chloroethyl vinyl ether

Chloromethane

Dibromomethane

Dichlorodifluoromethane

1,4-Dichloro-2-butene

1,1-Dichloroethane

1,2-Dichloropropane

1,2-Dichloroethane

cis-1,3-Dichloropropene

1,2-Dichloroethane-d4 (surrogate)

trans-1,3-Dichloropropene

1,1-Dichloroethene

1,1,1-Trichloroethane

trans-1,2-Dichloroethene

1,1,2-Trichloroethane

Iodomethane

Trichloroethene

Methylene chloride

Vinyl acetate

Trichlorofluoromethane

Vinyl chloride

Chlorobenzene-d5

-----  
Bromofluorobenzene (surrogate)

Chlorobenzene

Ethylbenzene

Ethyl methacrylate

2-Hexanone

4-Methyl-2-pentanone Styrene

1,1,2,2-Tetrachloroethane

Tetrachloroethene

Toluene

Toluene-d8 (surrogate)

1,2,3-Trichloropropane

Xylene



TABLE 6. CALIBRATION AND QC ACCEPTANCE CRITERIA

Parameter	Range for Q (ug/L)	Limit for s (ug/L)	Range for x (ug/L)	Range P, Ps (%)
Benzene	12.8-27.2	6.9	15.2-26.0	37-151
Bromodichloromethane	13.1-26.9	6.4	10.1-28.0	35-155
Bromoform	14.2-25.8	5.4	11.4-31.1	45-169
Bromomethane	2.8-37.2	17.9	D-41.2	D-242
Carbon tetrachloride	14.6-25.4	5.2	17.2-23.5	70-140
Chlorobenzene	13.2-26.8	6.3	16.4-27.4	37-160
2-Chloroethylvinyl ether	D-44.8	25.9	D-50.4	D-305
Chloroform	13.5-26.5	6.1	13.7-24.2	51-138
Chloromethane	D-40.8	19.8	D-45.9	D-273
Dibromochloromethane	13.5-26.5	6.1	13.8-26.6	53-149
1,2-Dichlorobenzene	12.6-27.4	7.1	11.8-34.7	18-190
1,3-Dichlorobenzene	14.6-25.4	5.5	17.0-28.8	59-156
1,4-Dichlorobenzene	12.6-27.4	7.1	11.8-34.7	18-190
1,1-Dichloroethane	14.5-25.5	5.1	14.2-28.4	59-155
1,2-Dichloroethane	13.6-26.4	6.0	14.3-27.4	49-155
1,1-Dichloroethene	10.1-29.9	9.1	3.7-42.3	D-234
trans-1,2-Dichloroethene	13.9-26.1	5.7	13.6-28.4	54-156
1,2-Dichloropropane	6.8-33.2	13.8	3.8-36.2	D-210
cis-1,3-Dichloropropene	4.8-35.2	15.8	1.0-39.0	D-227
trans-1,3-Dichloropropene	10.0-30.0	10.4	7.6-32.4	17-183
Ethyl benzene	11.8-28.2	7.5	17.4-26.7	37-162
Methylene chloride	12.1-27.9	7.4	D-41.0	D-221
1,1,2,2-Tetrachloroethane	12.1-27.9	7.4	13.5-27.2	46-157
Tetrachloroethene	14.7-25.3	5.0	17.0-26.6	64-148
Toluene	14.9-25.1	4.8	16.6-26.7	47-150
1,1,1-Trichloroethane	15.0-25.0	4.6	13.7-30.1	52-162
1,1,2-Trichloroethane	14.2-25.8	5.5	14.3-27.1	52-150
Trichloroethene	13.3-26.7	6.6	18.5-27.6	71-157
Trichlorofluoromethane	9.6-30.4	10.0	8.9-31.5	17-181
Vinyl chloride	0.8-39.2	20.0	D-43.5	D-251

Q = Concentration measured in QC check sample, in ug/L.

s = Standard deviation of four recovery measurements, in ug/L.

x = Average recovery for four recovery measurements, in ug/L.

P, Ps = Percent recovery measured.

D = Detected; result must be greater than zero.

a = Criteria from 40 CFR Part 136 for Method 624 and were calculated assuming a QC check sample concentration of 20 ug/L. These criteria are based directly upon the method performance data in Table 7. Where necessary, the limits for recovery have been broadened to assure applicability of the limits to concentrations below those used to develop Table 7.

TABLE 7. METHOD ACCURACY AND PRECISION AS FUNCTIONS OF CONCENTRATION(a)

Parameter	Accuracy, as recovery, x' (ug/L)	Single analyst precision, sr' (ug/L)	Overall precision, S' (ug/L)
Benzene	0.93C+2.00	0.26x-1.74	0.25x-1.33
Bromodichloromethane	1.03C-1.58	0.15x+0.59	0.20x+1.13
Bromoform	1.18C-2.35	0.12x+0.34	0.17x+1.38
Bromomethane	1.00C	0.43x	0.58x
Carbon tetrachloride	1.10C-1.68	0.12x+0.25	0.11x+0.37
Chlorobenzene	0.98C+2.28	0.16x-0.09	0.26x-1.92
Chloroethane	1.18C+0.81	0.14x+2.78	0.29x+1.75
2-Chloroethylvinyl ether(a)	1.00C	0.62x	0.84x
Chloroform	0.93C+0.33	0.16x+0.22	0.18x+0.16
Chloromethane	1.03C-1.81	0.37x+2.14	0.58x+0.43
Dibromochloromethane	1.01C-0.03	0.17x-0.18	0.17x+0.49
1,2-Dichlorobenzene(b)	0.94C+4.47	0.22x-1.45	0.30x-1.20
1,3-Dichlorobenzene	1.06C+1.68	0.14x-0.48	0.18x-0.82
1,4-Dichlorobenzene(b)	0.94C+4.47	0.22x-1.45	0.30x-1.20
1,1-Dichloroethane	1.05C+0.36	0.13x-0.05	0.16x+0.47
1,2-Dichloroethane	1.02C+0.45	0.17x-0.32	0.21x-0.38
1,1-Dichloroethene	1.12C+0.61	0.17x+1.06	0.43x-0.22
trans-1,2,-Dichloroethene	1.05C+0.03	0.14x+0.09	0.19x+0.17
1,2-Dichloropropane(b)	1.00C	0.33x	0.45x
cis-1,3-Dichloropropene(a)	1.00C	0.38x	0.52x
trans-1,3-Dichloropropene(b)	1.00C	0.25x	0.34x
Ethyl benzene	0.98C+2.48	0.14x+1.00	0.26x-1.72
Methylene chloride	0.87C+1.88	0.15x+1.07	0.32x+4.00
1,1,2,2-Tetrachloroethane	0.93C+1.76	0.16x+0.69	0.20x+0.41
Tetrachloroethene	1.06C+0.60	0.13x-0.18	0.16x-0.45
Toluene	0.98C+2.03	0.15x-0.71	0.22x-1.71
1,1,1-Trichloroethane	1.06C+0.73	0.12x-0.15	0.21x-0.39
1,1,2-Trichloroethane	0.95C+1.71	0.14x+0.02	0.18x+0.00
Trichloroethene	1.04C+2.27	0.13x+0.36	0.12x+0.59
Trichlorofluoromethane	0.99C+0.39	0.33x-1.48	0.34x-0.39
Vinyl chloride	1.00C	0.48x	0.65x

x' = Expected recovery for one or more measurements of a sample containing a concentration of C, in ug/L.

sr' = Expected single analyst standard deviation of measurements at an average concentration of x, in ug/L.

S' = Expected interlaboratory standard deviation of measurements at an average concentration found of x, in ug/L.

C = True value for the concentration, in ug/L.

x = Average recovery found for measurements of samples containing a concentration of C, in ug/L.

a = Estimates based upon the performance in a single laboratory.

b = Due to chromatographic resolution problems, performance statements for these isomers are based upon the sums of their concentrations.

TABLE 8. SURROGATE SPIKE RECOVERY LIMITS FOR WATER AND SOIL/SEDIMENT  
SAMPLES

Surrogate Compound	Low/High Water	Low/High Soil/Sediment
4-Bromofluorobenzene	86-115	74-121
1,2-Dichloroethane-d4	76-114	70-121
Toluene-d8	88-110	81-117

**California Laboratory Services  
Standard Operating Procedures**

**Title:** Ultrasonic Extraction

**Method Number:** 3550A

**Method Type:** Extraction, Sonication

**Revision Number:** 3550A-0

**Author:** Prags Govender

**Effective Date:** May 1, 1993

**Author's Title:** Supervisor

**Department:** Organic-Extraction

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**1.0 Scope and Application**

- 1.1 Method 3550 is a procedure for extracting nonvolatile and semivolatile organic compounds from solids such as soils, sludges, and wastes. The ultrasonic process ensures intimate contact of the sample matrix with the extraction solvent.
- 1.2 The method is divided into two sections, based on the expected concentration of organics in the sample. The low concentration method (individual organic components of < 20 mg/Kg) uses a larger sample size and a more rigorous extraction procedure (lower concentrations are more difficult to extract). The medium/high concentration method (individual organic components of > 20 mg/Kg) is much simpler and therefore faster.
- 1.3 It is highly recommended that the extracts be cleaned up prior to analysis. See CLS Organic Cleanup SOPs.

**2.0 Safety Issues**

- 2.1 Proper safety procedures are used when handling all chemicals and samples; this includes at a minimum wearing gloves, lab coat, and eye protection. See California Laboratory Services (CLS) Chemical Hygiene Plan for more detailed information on safety.

**3.0 Chain of Custody Compliance**

- 3.1 All samples removed from log-in are signed out. Aliquot taken from the original samples for analysis is accounted for by entering sample ID on the proper batch sheets during preparation and analysis. All documentation (raw data and general reports) and samples (this includes digested sample) are given their correct laboratory ID to assure total traceability. See CLS COC for more details.

#### **4.0 Summary of Method**

- 4.1 Low concentration method - A 30 g sample is mixed with anhydrous sodium sulfate to form a free-flowing powder. This is solvent-extracted three times using ultrasonic extraction. A portion of the extract is removed for cleanup and/or analysis.
- 4.2 Medium/high concentration method - A 2 g sample is mixed with anhydrous sodium sulfate to form a free-flowing powder. This mixture is solvent-extracted three times using ultrasonic extraction. The extract is separated from the sample by centrifugation. The extract is ready for cleanup and/or analysis following concentration.

#### **5.0 Sample Collection, Preservation, Containers, and Holding Time**

- 5.1 See COC SOP for a detailed listing of holding times, containers, and preservatives.

#### **6.0 Apparatus and Material**

- 6.1 Apparatus for grinding dry waste samples.
- 6.2 Ultrasonic preparation - A horn type ultrasonic extractor equipped with a titanium tip is used. The following ultrasonic extractors are used: Ultrasonic Disrupter - Heat Systems - Ultrasonics, Inc., Model W-385 (475 watt) and Model XL2020 (power wattage is a minimum of 375 with pulsing capability). Both models have No. 200 1/2" Tapped Disrupter Horn, No. 207 3/4" Tapped Disrupter Horn, and No. 419 1/8" Standard Tapered microtip probe.
- 6.3 Sonobox - Used with above disrupters for decreasing sound (Heat Systems - Ultrasonics, Inc., Model 432B).
- 6.4 Apparatus for determining percent dry weight.
  - 6.4.1 Oven - Drying.
  - 6.4.2 Desiccator.
  - 6.4.3 Crucibles - Porcelain and disposable aluminum.
- 6.5 Pasteur glass pipets - 1 mL, disposable.
- 6.6 Bottles - 8 oz. French square with teflon-lined caps.
- 6.7 Vacuum or pressure filtration apparatus.

- 6.7.1 Buchner funnel.
- 6.7.2 Filter paper - Whatman No. 41 or equivalent.
- 6.8 Kuderna-Danish (K-D) apparatus.
  - 6.8.1 Concentrator tube - 10 mL, graduated. A ground glass stopper is used to prevent evaporation of extracts.
  - 6.8.2 Evaporation flask - 500 mL. Attach to concentrator tube with clamps.
  - 6.8.3 Snyder column - Three ball macro.
  - 6.8.4 Snyder column - Two ball micro.
- 6.9 Boiling chips - Solvent extracted, approximately 10/40 mesh teflon.
- 6.10 Solvent Evaporator - Heated, capable of temperature control (+/- 5°C).
- 6.11 Balance - Top loading, capable of accurately weighing to the nearest 0.01 g.
- 6.12 Vials - 2 mL, for GC autosampler, with Teflon-lined screw caps or crimp tops.
- 6.13 Glass scintillation vials - 20 mL, with Teflon-lined screw caps.
- 6.14 Spatula - Stainless steel.
- 6.15 Syringe - 5 mL.
- 7.0 Reagents
  - 7.1 Reagent grade chemicals are used in all tests.
  - 7.2 Organic-free reagent water. All references to water in this method refer to organic-free reagent water.
  - 7.3 Sodium sulfate (granular, anhydrous),  $\text{Na}_2\text{SO}_4$ , purified by heating at 400°C for 4 hours in a shallow tray.
  - 7.4 Extraction solvents
    - 7.4.1 Methylene chloride: Acetone,  $\text{CH}_2\text{Cl}_2:\text{CH}_3\text{COCH}_3$  (1:1, v:v). Pesticide quality.

7.4.2 Methylene chloride,  $\text{CH}_2\text{Cl}_2$ . Pesticide quality.

7.4.3 Hexane,  $\text{C}_6\text{H}_{14}$ . Pesticide quality.

## 7.5 Exchange solvents

7.5.1 Hexane,  $\text{C}_6\text{H}_{14}$ . Pesticide quality.

7.5.2 Cyclohexane,  $\text{C}_6\text{H}_{12}$ . Pesticide quality.

7.5.3 Methanol,  $\text{CH}_3\text{OH}$ . Pesticide quality.

## 8.0 Interferences

8.1 N/A

## 9.0 Procedure

### 9.1 Sample handling

9.1.1 Sediment/soil samples - Decant and discard any water layer on a sediment sample. Mix sample thoroughly, especially composited samples. Discard any foreign objects such as sticks, leaves, and rocks.

9.2 Determination of percent dry weight - In certain cases, sample results on a dry weight basis are desired. When such data is required, a portion of sample for this determination is weighed out at the same time as the portion used for analytical determination.

9.2.1 Immediately after weighing the sample for extraction, weigh 5-10 g of the sample into a tared crucible. Determine the % dry weight of the sample by drying overnight at  $105^\circ\text{C}$ . Allow to cool in a desiccator before weighing:

$$\% \text{ dry weight} = \frac{\text{g of dry sample} \times 100}{\text{g of sample}}$$

9.3 Extraction method for samples expected to contain low concentrations of organics and pesticides (< 20 mg/Kg):

9.3.1 The following step is performed rapidly to avoid loss of the more volatile extractables. Weigh  $30 \pm 1.0$  g of sample into a 8 oz. bottle. Record the weight on the batch sheet. Nonporous or wet samples (gummy or clay type) that do not have a free-flowing sandy

texture must be mixed with 60 g of anhydrous sodium sulfate, using a spatula. If required, more sodium sulfate may be added. After addition of sodium sulfate, the sample should be free flowing. Add surrogate standards to all samples, spikes, standards, and blanks. For the sample in each analytical batch selected for spiking, add the matrix spiking standard.

- 9.3.2 Place the bottom surface of the tip of the No. 207 3/4" disrupter horn about 1/2" below the surface of the solvent, but above the sediment layer.
- 9.3.3 Extract ultrasonically for 3 minutes, with output control knob set at 10 (full power) and with mode switch on pulse (pulsing energy rather than continuous energy) and percent-duty cycle knob set at 50% (energy on 50% of time and off 50% of time). Do not use microtip probe.
- 9.3.4 Decant and filter extracts through Whatman No. 41 filter paper containing approximately 10 g sodium sulfate.
- 9.3.5 Repeat the extraction two more times with two additional 100 mL portions of solvent. Decant off the solvent after each ultrasonic extraction. On the final ultrasonic extraction, pour the entire sample through the filter paper and rinse with extraction solvent.
- 9.3.6 Assemble a Kuderna-Danish (K-D) concentrator by attaching a 10 mL concentrator tube to a 500 mL evaporator flask.
- 9.3.7 Collect the dried extract in the K-D concentrator. Wash the extractor flask with extraction solvent to complete the quantitative transfer.
- 9.3.8 Add one to two clean boiling chips to the evaporation flask, and attach a three ball Snyder column. Prewet the Snyder column by adding about 1 mL methylene chloride to the top. Place the K-D apparatus on the solvent evaporator (80-90°C) so that the concentrator tube is partially immersed in the hot water and the entire lower rounded surface of the flask is bathed with hot vapor. Adjust the vertical position of the apparatus and the water temperature, as required, to complete the concentration in 10-15 minutes. At the proper rate of distillation the balls of the column will actively chatter, but the chambers will not flood with condensed solvent. When the apparent volume of liquid reaches 1 mL, remove the K-D apparatus and allow it to drain and cool for at least 10 minutes.
- 9.3.9 If a solvent exchange is required, momentarily remove the Snyder column, add 10 mL of the exchange solvent, and re-attach the Snyder column. Concentrate the extract to approximately 2 mL, raising the temperature of the water bath, if necessary, to maintain proper distillation. When the apparent volume again reaches 1-2 mL, remove the K-D apparatus and allow it to drain and cool for at least 10 minutes.
- 9.3.10 Remove the Snyder column and rinse the flask and its lower joints into the concentrator tube with 1-2 mL of methylene chloride or exchange solvent.



- 9.3.11 If further concentration is required, either microSnyder column technique (Section 9.3.11.1) or nitrogen blowdown technique (Section 9.3.11.2) is used to adjust the extract to the final volume required.

9.3.11.1 MicroSnyder Column Technique

- 9.3.11.1.1 Add a clean boiling chip and attach a two ball Snyder column to the concentrator tube. Prewet the column by adding approximately 0.5 mL of methylene chloride or exchange solvent through the top. Place the apparatus in the hot water bath. Adjust the vertical position and the water temperature, as required, to complete the concentration in 5-10 minutes. At the proper rate of distillation the balls of the column will actively chatter, but the chambers will not flood. When the liquid reaches an apparent volume of approximately 0.5 mL, remove the apparatus from the water bath and allow to drain and cool for at least 10 minutes. Remove the micro Snyder column and rinse its lower joint with approximately 0.2 mL of appropriate solvent and add to the concentrator tube. Adjust the final volume to the volume required for cleanup or for the determinative method.

9.3.11.2 Nitrogen Blowdown Technique

- 9.3.11.2.1 Place the concentrator tube in a warm water bath (approximately 35°C) and evaporate the solvent volume to the required level using a gentle stream of clean, dry nitrogen.
- 9.3.11.2.2 The internal wall of the tube is rinsed down several times with the appropriate solvent during the operation. During evaporation, the solvent level in the tube must be positioned to prevent water from condensing into the sample (i.e., the solvent level should be below the level of the water bath). Under normal operating conditions, the extract should not be allowed to become dry.

**CAUTION:** When the volume of solvent is reduced below 1 mL, semivolatile analytes may be lost.

- 9.4 Transfer the extract to a vial with a Teflon-lined cap and label appropriately. Adjust the final volume as specified. Ready the extract for analysis (transfer to appropriate department).
- 9.5 Extraction method for samples expected to contain high concentrations of organics (> 20 mg/Kg):
- 9.5.1 Transfer approximately  $2 \pm 0.1$  g of sample to a 20 mL vial. Wipe the mouth of the vial with a tissue to remove any sample material. Record the exact weight of sample taken. Cap the

vial before proceeding with the next sample to avoid any cross-contamination.

9.5.2 Add 2 g of anhydrous sodium sulfate to sample in the 20 mL vial and mix well.

9.5.3 Immediately add whatever volume of solvent is necessary to bring the final volume to 10.0 mL considering the added volume of surrogates and matrix spikes. Disrupt the sample with the 1/8" tapered microtip ultrasonic probe for 2 minutes at output control setting 5 and with mode switch on pulse and percent duty cycle at 50%. Extraction solvents are:

1. Nonpolar compounds (i.e., organochlorine pesticides and PCBs), hexane or appropriate solvent.
2. Extractable priority pollutants, methylene chloride.

9.5.4 Loosely pack disposable Pasteur pipets with 2 to 3 cm Pyrex glass wool plugs. Filter the extract through the glass wool and collect 5.0 mL in a concentrator tube if further concentration is required. Follow Section 9.3.11 for details on concentration. Normally, the 5.0 mL extract is concentrated to approximately 1.0 mL or less.

9.5.5 The extract is ready for cleanup or analysis, depending on the extent of interfering co-extractives.

## 10.0 Quality Control

10.1 Quality control procedures (control limits, etc.) are given in detail in the CLS Quality Control SOP. Standard quality control for each batch is outlined below:

10.1.1 One method blank.

10.1.2 One matrix spike.

10.1.3 One matrix spike duplicate.

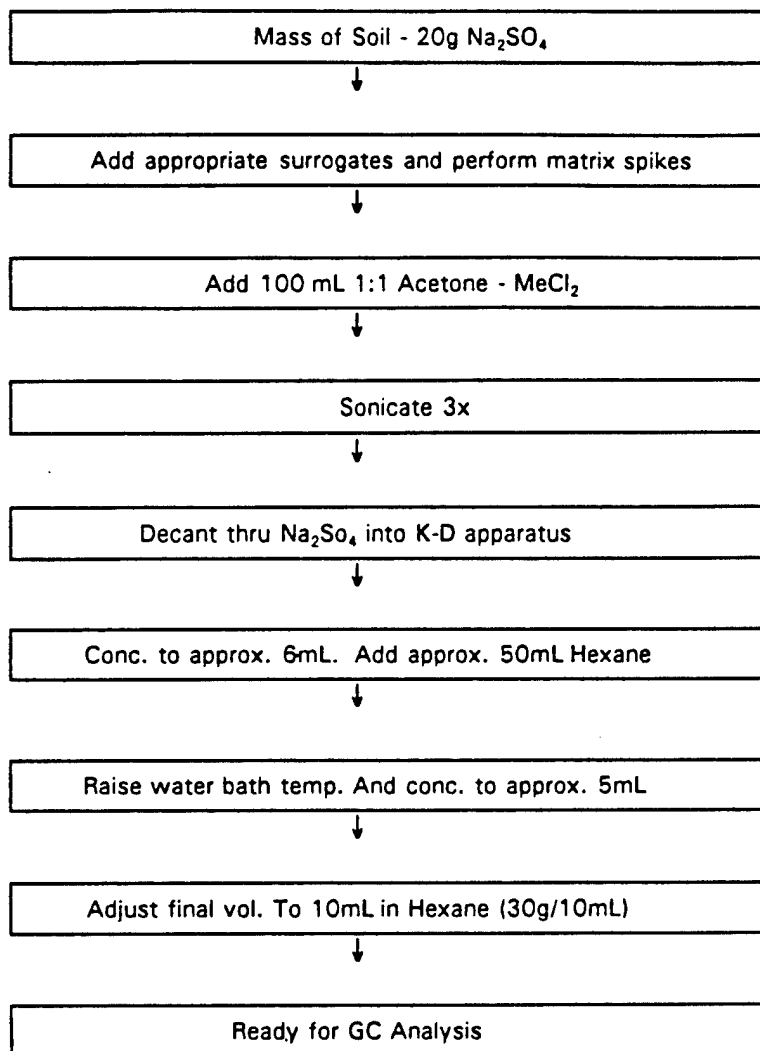
10.1.4 One laboratory control sample (LCS).

10.2 Corrective actions are detailed in the CLS Corrective Action SOP.

## 11.0 References

11.1 SW-8468.0 QUALITY CONTROL

## EXTRACTION FLOW CHART



R:\sops\Method\3550a-0. Mvd (042597)

METHOD #: 5030A      NONPROMULGATED (SW-846 Proposed Update I, Nov. 1990)

TITLE:      Purge-And-Trap

ANALYTE:

    Volatile organics

INSTRUMENTATION: N/A

## 1.0 SCOPE AND APPLICATION

- 1.1 This method describes sample preparation and extraction for the analysis of volatile organics by a purge-and-trap procedure. The gas chromatographic determinative steps are found in Methods 8010, 8015, 8020, 8021 and 8030. Although applicable to Methods 8240 and 8260, the purge-and-trap procedure is already incorporated into Methods 8240 and 8260.
- 1.2 Method 5030 can be used for most volatile organic compounds that have boiling points below 200-C and are insoluble or slightly soluble in water. Volatile water-soluble compounds can be included in this analytical technique; however, quantitation limits (by GC or GC/MS) are approximately ten times higher because of poor purging efficiency. The method is also limited to compounds that elute as sharp peaks from a GC column packed with graphitized carbon lightly coated with a carbowax or a coated capillary column. Such compounds include low molecular weight halogenated hydrocarbons, aromatics, ketones, nitriles, acetates, acrylates, ethers, and sulfides.
- 1.3 Water samples can be analyzed directly for volatile organic compounds by purge-and-trap extraction and gas chromatography. Higher concentrations of these analytes in water can be determined by direct injection of the sample into the chromatographic system.
- 1.4 This method also describes the preparation of water-miscible liquids, solids, wastes, and soils/sediments for analysis by the purge-and-trap procedure.

## 2.0 SUMMARY OF METHOD

- 2.1 The purge-and-trap process: An inert gas is bubbled through the solution at ambient temperature, and the volatile components are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the volatile components are adsorbed. After purging is completed, the sorbent column is heated and backflushed with inert gas to desorb the components onto a gas chromatographic column.
- 2.2 If the sample introduction technique in Section 2.1 is not applicable, a portion of the sample is dispersed in methanol to dissolve the volatile organic constituents. A portion of the methanolic solution is combined with water in a specially designed purging chamber. It is then analyzed by purge-and-trap GC following the normal water method.

### 3.0 INTERFERENCES

- 3.1 Impurities in the purge gas, and from organic compounds out-gassing from the plumbing ahead of the trap, account for the majority of contamination problems. The analytical system must be demonstrated to be free from contamination under the conditions of the analysis by running laboratory reagent blanks. The use of non-TFE plastic coating, non-TFE thread sealants, or flow controllers with rubber components in the purging device should be avoided.
- 3.2 Samples can be contaminated by diffusion of volatile organics (particularly methylene chloride and fluorocarbons) through the septum seal of the sample vial during shipment and storage. A trip blank prepared from organic-free reagent water and carried through sampling and handling protocols serves as a check on such contamination.
- 3.3 Contamination by carryover can occur whenever high-concentration and low-concentration samples are analyzed sequentially. Whenever an unusually concentrated sample is analyzed, it should be followed by an analysis of organic-free reagent water to check for cross-contamination. The trap and other parts of the system are subject to contamination. Therefore, frequent bake-out and purging of the entire system may be required.
- 3.4 The laboratory where volatile analysis is performed should be completely free of solvents.

### 4.0 APPARATUS AND MATERIALS

- 4.1 Microsyringes - 10,  $\mu$ L, 25  $\mu$ L, 100,  $\mu$ L, 250,  $\mu$ L, 500,  $\mu$ L, and 1,000  $\mu$ L. These syringes should be equipped with a 20 gauge (0.006 in ID) needle having a length sufficient to extend from the sample inlet to within 1 cm of the glass frit in the purging device. The needle length will depend upon the dimensions of the purging device employed.
- 4.2 Syringe valve - Two-way, with Luer ends (three each), if applicable to the purging device.
- 4.3 Syringe - 5 mL, gas-tight with shutoff valve.
- 4.4 Analytical balance - 0.0001 g.
- 4.5 Top-loading balance - 0.1 g.
- 4.6 Glass scintillation vials - 20 mL, with screw-caps and Teflon liners or glass culture tubes with screw-caps and Teflon liners.
- 4.7 Volumetric flasks, Class A - 10 mL and 100 mL, with ground-glass stoppers.
- 4.8 Vials - 2 mL, for GC autosampler.
- 4.9 Spatula - Stainless steel.
- 4.10 Disposable pipets - Pasteur.
- 4.11 Purge-and-trap device: The purge-and-trap device consists of three separate pieces of equipment: the sample purger, the trap, and the desorber. Several complete devices are commercially available.
  - 4.11.1 The recommended purging chamber is designed to accept 5 mL samples with a water column at least 3 cm deep. The gaseous headspace between the water column and the trap must have a total

volume of less than 15 mL. The purge gas must pass through the water column as finely divided bubbles with a diameter of less than 3 mm at the origin. The purge gas must be introduced no more than 5 mm from the base of the water column. The sample purger, illustrated in Figure 1, meets these design criteria. Alternate sample purge devices may be used, provided equivalent performance is demonstrated.

- 4.11.2 The trap must be at least 25 cm long and have an inside diameter of at least 0.105 in. starting from the inlet, the trap must contain the following amounts of adsorbents: 1/3 of 2,6-diphenylene oxide polymer, 1/3 of silica gel, and 1/3 of coconut charcoal. It is recommended that 1.0 cm of methyl silicone-coated packing be inserted at the inlet to extend the life of the trap (see Figures 2 and 3). If it is not necessary to analyze for dichlorodifluoromethane or other fluorocarbons of similar volatility, the charcoal can be eliminated and the polymer increased to fill 2/3 of the trap. If only compounds boiling above 35-C are to be analyzed, both the silica gel and charcoal can be eliminated and the polymer increased to fill the entire trap. Before initial use, the trap should be conditioned overnight at 180-C by backflushing with an inert gas flow of at least 20 mL/min. Vent the trap effluent to the hood, not to the analytical column. Prior to daily use, the trap should be conditioned for 10 min at 180-C with backflushing. The trap may be vented to the analytical column during daily conditioning; however, the column must be run through the temperature program prior to analysis of samples.
- 4.11.3 The desorber should be capable of rapidly heating the trap to 180-C for desorption. The polymer section of the trap should not be heated higher than 180-C, and the remaining sections should not exceed 220-C during bake-out mode. The desorber design illustrated in Figures 2 and 3 meet these criteria.
- 4.11.4 The purge-and-trap device may be assembled as a separate unit or may be coupled to a gas chromatograph, as shown in Figures 4 and 5.
- 4.11.5 Trap Packing Materials

- 4.11.5.1 2,6-Diphenylene oxide polymer - 60/80 mesh, chromatographic grade (Tenax GC or equivalent).
- 4.11.5.2 Methyl silicone packing - OV-1 (3%) on Chromosorb-W, 60/80 mesh or equivalent.
- 4.11.5.3 Silica gel - 35/60 mesh, Davison, grade 15 or equivalent.
- 4.11.5.4 Coconut charcoal - Prepare from Barnebey Cheney, CA-580-26 lot #M-2649, or equivalent, by crushing through 26 mesh screen.

- 4.12 Heater or heated oil bath - capable of maintaining the purging chamber to within 1-C, over a temperature range from ambient to 100-C.

## 5.0 REAGENTS

- 5.1 Organic-free reagent water - All references to water in this method refer to organic-free reagent water, as defined in Chapter One.
- 5.2 Methanol, CH<sub>3</sub>OH - Pesticide quality or equivalent. Store away from other solvents.

## 6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

- 6.1 Refer to the introductory material to this chapter, Organic Analytes, Section 4.1. Samples should be stored in capped bottles, with minimum headspace, at 4-C or less.

## 7.0 PROCEDURE

- 7.1 Initial calibration: Prior to using this introduction technique for any GC method, the system must be calibrated. General calibration procedures are discussed in Method 8000, while the specific determinative methods and Method 3500 give details on preparation of standards.
  - 7.1.1 Assemble a purge-and-trap device that meets the specification in Section 4.10. Condition the trap overnight at 180-C in the purge mode with an inert gas flow of at least 20 mL/min. Prior to use, condition the trap daily for 10 min. while backflushing at 180-C with the column at 220-C.
  - 7.1.2 Connect the purge-and-trap device to a gas chromatograph.
  - 7.1.3 Prepare the final solutions containing the required concentrations of calibration standards, including surrogate standards, directly in the purging device. Add 5.0 mL of organic-free reagent water to the purging device. The organic-free reagent water is added to the purging device using a 5 mL glass syringe fitted with a 15 cm 20-gauge needle. The needle is inserted through the sample inlet shown in Figure 1. The internal diameter of the 14-gauge needle that forms the sample inlet will permit insertion of the 20-gauge needle. Next, using a 10 uL or 25 uL micro-syringe equipped with a long needle (Section 4.1), take a volume of the secondary dilution solution containing appropriate concentrations of the calibration standards. Add the aliquot of calibration solution directly to the organic-free reagent water in the purging device by inserting the needle through the sample inlet. When discharging the contents of the micro-syringe, be sure that the end of the syringe needle is well beneath the surface of the organic-free reagent water. Similarly, add 10 uL of the internal standard solution. Close the 2-way syringe valve at the sample inlet.
  - 7.1.4 Carry out the purge-and-trap analysis procedure using the specific conditions given in Table 1.
  - 7.1.5 Calculate response factors or calibration factors for each analyze of interest using the procedure described in Method 8000.



7.1.6 The average RF must be calculated for each compound. A system performance check should be made before this calibration curve is used. If the purge-and-trap procedure is used with Method 8010, the following five compounds are checked for a minimum average response factor: chloromethane; 1,1-dichloroethane; bromoform; 1,1,2,2-tetrachloroethane; and chlorobenzene. The minimum acceptable average RF for these compounds should be 0.300 (0.250 for bromoform). These compounds typically have RFs of 0.4-0.6, and are used to check compound stability and to check for degradation caused by contaminated lines or active sites in the system. Examples of these occurrences are:

7.1.6.1 Chloromethane: This compound is the most likely compound to be lost if the purge flow is too fast.

7.1.6.2 Bromoform: This compound is one of the compounds most likely to be purged very poorly if the purge flow is too slow. Cold spots and/or active sites in the transfer lines may adversely affect response.

7.1.6.3 Tetrachloroethane and 1,1-dichloroethane: These compounds are degraded by contaminated transfer lines in purge-and-trap systems and/or active sites in trapping materials.

7.2 On-going calibration: Refer to Method 8000 for details on continuing calibration.

7.3 Sample preparation

7.3.1 Water samples

7.3.1.1 Screening of the sample prior to purge-and-trap analysis will provide guidance on whether sample dilution is necessary and will prevent contamination of the purge-and-trap system. Two screening techniques that can be utilized are: the use of an automated headspace sampler (modified Method 3810), interfaced to a gas chromatograph (GC), equipped with a photo ionization detector (PID), in series with an electrolytic conductivity detector (HECD); and extraction of the sample with hexadecane (Method 3820) and analysis of the extract on a GC with a FID and/or an ECD.

7.3.1.2 All samples and standard solutions must be allowed to warm to ambient temperature before analysis.

7.3.1.3 Assemble the purge-and-trap device. The operating conditions for the GC are given in Section 7.0 of the specific determinative method to be employed.

7.3.1.4 Daily GC calibration criteria must be met (Method 8000) before analyzing samples.

7.3.1.5 Adjust the purge gas flow rate (nitrogen or helium) to that shown in Table 1, on the purge-and-trap device. Optimize the flow rate to provide the best response for chloromethane and bromoform, if these compounds are

analytes. Excessive flow rate reduces chloromethane response, whereas insufficient flow reduces bromoform response.

7.3.1.6 Remove the plunger from a 5 mL syringe and attach a closed syringe valve. Open the sample or standard bottle, which has been allowed to come to ambient temperature, and carefully pour the sample into the syringe barrel to just short of overflowing. Replace the syringe plunger and compress the sample. Open the syringe valve and vent any residual air while adjusting the sample volume to 5.0 mL. This process of taking an aliquot destroys the validity of the liquid sample for future analysis; therefore, if there is only one VOA vial, the analyst should fill a second syringe at this time to protect against possible loss of sample integrity. This second sample is maintained only until such time when the analyst has determined that the first sample has been analyzed properly. Filling one 20 mL syringe would allow the use of only one syringe. If a second analysis is needed from a syringe, it must be analyzed within 24 hr. Care must be taken to prevent air from leaking into the syringe.

7.3.1.7 The following procedure is appropriate for diluting purgeable samples. All steps must be performed without delays until the diluted sample is in a gas-tight syringe.

7.3.1.7.1 Dilutions may be made in volumetric flasks (10 mL to 100 mL). Select the volumetric flask that will allow for the necessary dilution. Intermediate dilutions may be necessary for extremely large dilutions.

7.3.1.7.2 Calculate the approximate volume of organic-free reagent water to be added to the volumetric flask selected and add slightly less than this quantity of organic-free reagent water to the flask.

7.3.1.7.3 Inject the proper aliquot of samples from the syringe prepared in Section 7.3.1.5 into the flask. Aliquots of less than 1 mL are not recommended. Dilute the sample to the mark with organic-free reagent water. Cap the flask, invert, and shake three times. Repeat the above procedure for additional dilutions.

7.3.1.7.4 Fill a 5 mL syringe with the diluted sample as in Section 7.3.1.5.

7.3.1.8 Add 10.0 uL of surrogate spiking solution (found in each determinative method, Section 5.0) and, if applicable, 10 uL of internal standard spiking solution through the valve bore of the syringe; then close the valve. The surrogate and internal standards may be mixed and added as a single spiking solution. Matrix spiking solutions, if indicated, should be added (10 uL) to the sample at this time.

7.3.1.9 Attach the syringe-syringe valve assembly to the syringe

valve on the purging device. Open the syringe valves and inject the sample into the purging chamber.

7.3.1.10 Close both valves and purge the sample for the time and at the temperature specified in Table 1.

7.3.1.11 At the conclusion of the purge time, attach the trap to the chromatograph, adjust the device to the desorb mode, and begin the gas chromatographic temperature program and GC data acquisition. Concurrently, introduce the trapped materials to the gas chromatographic column by rapidly heating the trap to 180-C while backflushing the trap with inert gas between 20 and 60 mL/min for the time specified in Table 1.

7.3.1.12 While the trap is being desorbed into the gas chromatograph, empty the purging chamber. Wash the chamber with a minimum of two 5 mL flushes of organic-free reagent water (or methanol followed by organic-free reagent water) to avoid carryover of pollutant compounds into subsequent analyses.

7.3.1.13 After desorbing the sample, recondition the trap by

7.3.1.13 After desorbing the sample, recondition the trap by returning the purge-and-trap device to the purge mode. Wait 15 sec; then close the syringe valve on the purging device to begin gas flow through the trap. The trap temperature should be maintained at 180-C for Methods 8010, 8020, 8021, 8240 and 8260 and 210-C for Methods 8015 and 8030. Trap temperatures up to 220-C may be employed. However, the higher temperatures will shorten the useful life of the trap. After approximately 7 min, turn off the trap heater and open the syringe valve to stop the gas flow through the trap. When cool, the trap is ready for the next sample.

7.3.1.14 If the initial analysis of a sample or a dilution of the sample has a concentration of analytes that exceeds the initial calibration range, the sample must be reanalyzed at a higher dilution. When a sample is analyzed that has saturated response from a compound, this analysis must be followed by a blank organic-free reagent water analysis. If the blank analysis is not free of interferences, the system must be decontaminated. Sample analysis may not resume until a blank can be analyzed that is free of interferences.

7.3.1.15 All dilutions should keep the response of the major constituents (previously saturated peaks) in the upper half of the linear range of the curve. Proceed to Method 8000 and the specific determinative method for details on calculating analyze response.

#### 7.3.2 Water-miscible liquids:

7.3.2.1 Water-miscible liquids are analyzed as water samples after first diluting them at least 50-fold with organic-free reagent water.

7.3.2.2 Initial and serial dilutions can be prepared by pipetting 2 mL of the sample into a 100 mL volumetric flask and diluting to volume with organic-free reagent water. Transfer immediately to a 5 mL gas-tight syringe.

7.3.2.3 Alternatively, prepare dilutions directly in a 5 mL syringe filled with organic-free reagent water by adding at least 20 uL, but not more than 100 uL of liquid sample. The sample is ready for addition of surrogate and, if applicable, internal and matrix spiking standards.

7.3.3 Sediment/soil and waste samples: It is highly recommended that all samples of this type be screened prior to the purge-and-trap GC analysis. These samples may contain percent quantities of purgeable organics that will contaminate the purge-and-trap system, and require extensive cleanup and instrument downtime. See Section 7.3.1.1 for recommended screening techniques. Use the screening data to determine whether to use the low-concentration method (0.005-1 mg/Kg) or the high concentration method (>1 mg/Kg).

7.3.3.1 Low-concentration method: This is designed for samples containing individual purgeable compounds of <1 mg/Kg. It is limited to sediment/soil samples and waste that is of a similar consistency (granular and porous). The low-concentration method is based on purging a heated sediment/soil sample mixed with organic-free reagent water containing the surrogate and, if applicable, internal and matrix spiking standards. Analyze all reagent blanks and standards under the same conditions as the samples.

7.3.3.1.1 Use a 5 g sample if the expected concentration is <0.1 mg/Kg or a 1 g sample for expected concentrations between 0.1 and 1 mg/Kg.

7.3.3.1.2 The GC system should be set up as in Section 7.0 of the specific determinative method. This should be done prior to the preparation of the sample to avoid loss of volatile from standards and samples. A heated purge calibration curve must be prepared and used for the quantitation of all samples analyzed with the low-concentration method. Follow the initial and daily calibration instructions, except for the addition of a 40-C purge temperature for Methods 8010, 8020, and 8021.

7.3.3.1.3 Remove the plunger from a 5 mL Luerlock type syringe equipped with a syringe valve and fill until overflowing with organic-free reagent water. Replace the plunger and compress the reagent water to vent trapped air. Adjust the volume to 5.0 mL. Add 10 uL each of surrogate spiking solution and internal

standard solution to the syringe through the valve. (Surrogate spiking solution and internal standard solution may be mixed together.) Matrix spiking solutions, if indicated, should be added (10 uL) to the sample at this time.

7.3.3.1.4 The sample (for volatile organics) consists of the entire contents of the sample container. Do not discard any supernatant liquids. Mix the contents of the sample container with a narrow metal spatula. Weigh the amount determined in Section 7.3.3.1.1 into a tared purge device. Note and record the actual weight to the nearest 0.1 g.

7.3.3.1.5 Determination of sample % dry weight - In certain cases, sample results are desired based on dry weight basis. When such data is desired, a portion of sample for this determination should be weighed out at the same time as the portion used for analytical determination.

WARNING: The drying oven should be contained in a hood or vented. Significant laboratory contamination may result from a heavily contaminated hazardous waste sample.

7.3.3.1.5.1 Immediately after weighing the sample for extraction, weigh 5-10 g of the sample into a tared crucible. Determine the % dry weight of the sample by drying overnight at 105-C. Allow to cool in a desiccator before weighing:

$$\% \text{ dry weight} = \frac{\text{g of dry sample}}{\text{g of sample}} \times 100$$

7.3.3.1.6 Add the spiked organic-free reagent water to the purge device, which contains the weighed amount of sample, and connect the device to the purge-and-trap system.

[NOTE: Prior to the attachment of the purge device, Sections 7.3.3.1.4 and 7.3.3.1.6 must be performed rapidly and without interruption to avoid loss of volatile organics. These steps must be performed in a laboratory free of solvent fumes.]

7.3.3.1.7 Heat the sample to 40-C + 1-C (Methods 80101 8020 and 8021) or to 85-C +/- 2-C (Methods 8015 and 8030) and purge the sample for the time shown in Table 1.

7.3.3.1.8 Proceed with the analysis as outlined in Sections 7.3.1.11-7.3.1.15. Use 5 mL of the same organic-free reagent water as in the reagent blank. If saturated peaks occurred or would occur if a 1 g sample were analyzed, the high-concentration method must be followed.

7.3.3.2 High-concentration method: The method is based on extracting the sediment/soil with methanol. A waste sample is either extracted or diluted, depending on its solubility in methanol. An aliquot of the extract is added to organic-free reagent water containing surrogate and, if applicable, internal and matrix spiking standards. This is purged at the temperatures indicated in Table 1. All samples with an expected concentration of >1.0 mg/Kg should be analyzed by this method.

7.3.3.2.1 The sample (for volatile organics) consists of the entire contents of the sample container. Do not discard any supernatant liquids. Mix the contents of the sample container with a narrow metal spatula. For sediment/soil and waste that are insoluble in methanol, weigh 4 g (wet weight) of sample into a tared 20 mL vial. Use a top-loading balance. Note and record the actual weight to 0.1 gram and determine the percent dry weight of the sample using the procedure in Section 7.3.3.1.5. For waste that is soluble in methanol, weigh 1 g (wet weight) into a tared scintillation vial or culture tube or a 10 mL volumetric flask. (If a vial or tube is used, it must be calibrated prior to use. Pipet 10.0 mL of methanol into the vial and mark the bottom of the meniscus. Discard this solvent.)

7.3.3.2.2 Quickly add 9.0 mL of methanol; then add 1.0 mL of the surrogate spiking solution to the vial. Cap and shake for 2 min.

[NOTE: Sections 7.3.3.2.1 and 7.3.3.2.2 must be performed rapidly and without interruption to avoid loss of volatile organics. These steps must be performed in a laboratory free from solvent fumes.]

7.3.3.2.3 Pipet approximately 1 mL of the extract into a GC vial for storage, using a disposable pipet. The remainder may be discarded. Transfer approximately 1 mL of reagent methanol to a separate GC vial for use as the method blank for each set of samples. These extracts may be stored at 4-C in the dark, prior to analysis.

7.3.3.2.4 The GC system should be set up as in Section 7.0 of the specific determinative method. This should be

done prior to the addition of the methanol extract to organic-free reagent water.

- 7.3.3.2.5 Table 2 can be used to determine the volume of methanol extract to add to the 5 mL of organic-free reagent water for analysis. If a screening procedure was followed, use the estimated concentration to determine the appropriate volume. Otherwise, estimate the concentration range of the sample from the low-concentration analysis to determine the appropriate volume. If the sample was submitted as a high-concentration sample, start with 100 uL. All dilutions must keep the response of the major constituents (previously saturated peaks) in the upper half of the linear range of the curve.
- 7.3.3.2.6 Remove the plunger from a 5.0 mL Luerlock type syringe equipped with a syringe valve and fill until overflowing with organic-free reagent water. Replace the plunger and compress the water to vent trapped air. Adjust the volume to 4.9 mL. Pull the plunger back to 5.0 mL to allow volume for the addition of the sample extract and of standards. Add 10 uL of internal standard solution. Also add the volume of methanol extract determined in Section 7.3.3.2.5 and a volume of methanol solvent to total 100 uL (excluding methanol in standards).
- 7.3.3.2.7 Attach the syringe-syringe valve assembly to the syringe valve on the purging device. Open the syringe valve and inject the water/methanol sample into the purging chamber.
- 7.3.3.2.8 Proceed with the analysis as outlined in the specific determinative method. Analyze all reagent blanks on the same instrument as that used for the samples. The standards and blanks should also contain 100 uL of methanol to simulate the sample conditions.
- 7.3.3.2.9 For a matrix spike in the high-concentration sediment/soil samples, add 8.0 mL of methanol, 1.0 mL of surrogate spike solution and 1.0 mL of matrix spike solution. Add a 100 uL aliquot of this extract to 5 mL of water for purging (as per Section 7.3.3.2.6).

#### 7.4 Sample analysis:

- 7.4.1 The samples prepared by this method may be analyzed by Methods 8010, 8015, 8020, 8021, 8030, 8240, and 8260. Refer to these methods for appropriate analysis conditions.

#### 8.0 QUALITY CONTROL

- 8.1 Refer to Chapter One for specific quality control procedures and Method 3500 for sample preparation procedures.

8.2 Before processing any samples, the analyst should demonstrate through the analysis of an organic-free reagent water method blank that all glassware and reagents are interference free. Each time a set of samples is extracted, or there is a change in reagents, a method blank should be processed as a safeguard against chronic laboratory contamination. The blank samples should be carried through all stages of the sample preparation and measurement.

## 9.0 METHOD PERFORMANCE

9.1 Refer to the determinative methods for performance data.

## 10.0 REFERENCES

1. U.S. EPA 40 CFR Part 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; Final Rule and Interim Final Rule and Proposed Rule, " October 26, 1984.

TABLE 1  
PURGE-AND-TRAP OPERATING PARAMETERS

	Analysis Method			
	8010	8015	8020/8021	8030
Purge gas	Nitrogen or Helium	Nitrogen or Helium	Nitrogen or Helium	Nitrogen or Helium
Purge gas flow rate (mL/min)	40	20	40	20
Purge time (min)	11.0 +/-0.1	15.0 +/-0.1	11.0 +/-0.1	15.0 +/-0.1
Purge temperature (C)	Ambient	85 +/-2	Ambient	85 +/- 2
Desorb temperature (C)	180	180	180	180
Backflush inert gas flow (mL/min)	20-60	20-60	20-60	20-60
Desorb time (min)	4	1.5	4	1.5

TABLE 2. QUANTITY OF METHANOL EXTRACT REQUIRED FOR ANALYSIS OF HIGH-CONCENTRATION SOILS/SEDIMENTS

Approximate Concentration Range	Volume of Methanol Extract(a)
500-10,000 ug/Kg	100 uL
1,000-20,000 ug/Kg	50 uL
5,000-100,000 ug/Kg	10 uL
25,000-500,000 ug/Kg	100 uL of 1/50 dilution(b)



Calculate appropriate dilution factor for concentrations exceeding this table.

- a The volume of methanol added to 5 mL of water being purged should be kept constant. Therefore, add to the 5 mL syringe whatever volume of methanol is necessary to maintain a volume of 100 uL added to the syringe.
- b Dilute an aliquot of the methanol extract and then take 100 uL for analysis.

California Laboratory Services  
Standard Operating Procedures

**Title:** pH

**Method Number:** 9040/9045

**Method Type:** Electrometric

**Revision Number:** 9040/9045-1

**Author:**

**Effective Date:** Jan. 31, 1996

**Author's Title:** Inorganic Chemist

**Department:** Inorganic

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## **1.0 Scope and Application**

- 1.1 Method 9040 and 9045 are an electrometric procedure which has been approved for measuring pH in water and soils.

## **2.0 Safety Issues**

- 2.1 Proper safety procedures should be used when handling all chemicals and samples, this includes at a minimum wearing gloves, lab coat, and eye protection. See California Laboratory Services (CLS) Safety plan for more detailed information on safety.

## **3.0 Chain of Custody Compliance**

- 3.1 All samples removed from login must be signed out. Aliquot taken from the original samples for analysis will be accounted for by entering sample ID in the proper log books during preparation and analysis. All documentation (raw data and general reports) and samples (this includes digested sample) should be given their correct laboratory ID to assure total traceability. See CLS COC SOP for more details.

## **4.0 Summary of Method**

- 4.1 The soil sample is mixed either with Type II water or with a calcium chloride solution (see Section 5.0), depending on whether the soil is considered calcareous or noncalcareous. The pH of the solution is then measured with a pH meter.

## **5.0 Sample Collection, Preservation, Containers, and Holding Time**

- 5.1 The following is needed for water sample analysis:

5.1.1 At least 25 mL of water.

5.1.2 The water needs to have been kept at 4°C in a plastic or glass container.

5.1.3 The sample should be analyzed immediately upon arrival at the laboratory.

5.2 The following is needed for soil sample analysis:

5.2.1 At least 10g of soil.

5.2.2 The soil should be collected in glass jars and preserved at 4°C.

5.2.3 The sample should be analyzed immediately upon arrival at the laboratory.

## **6.0 Apparatus and Material**

6.1 pH meter, Orion Model 720 pH/ISE Meter

6.2 Glass electrode: Orion Model 91-56 Combination pH electrode.

6.3 Reference electrode: A silver-silver chloride reference electrode is built into the Model 91-56.

6.4 Magnetic stirrer and Teflon-coated stirring bar.

6.5 Thermometer or temperature sensor for automatic compensation.

## **7.0 Reagents**

7.1 Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.2 Primary standard buffer salts are available from the National Institute of Standards and Technology (Special Publication 260) and should be used in situations where extreme accuracy is necessary. Preparation of reference solutions from these salts requires some special precautions and handling, such as low-conductivity dilution water, drying ovens, and carbon-dioxide-free purge gas. These solutions should be replaced at least once each month.

7.3 Secondary standard buffers are purchased from Fisher Scientific. pH 4.01 (SB 101-4), pH 7.00 (SB 107-4) and pH 10.01 (SB 115-4). Check buffers are purchased from VWR, pH 5.00 (34170-109) and pH 8.00 (34170-118).

## **8.0 Interferences**

8.1 The glass electrode, in general, is not subject to solution interferences from color, turbidity, colloidal matter, oxidants, reductants, or high salinity.

- 8.2 Sodium error at pH levels >10 can be reduced or eliminated by using a low-sodium-error electrode.
- 8.3 Coatings of oily material or particulate matter can impair electrode response. These coatings can usually be removed by gentle wiping or detergent washing, followed by rinsing with distilled water. An additional treatment with hydrochloric acid (1:10) may be necessary to remove any remaining film.
- 8.4 Temperature effects on the electrometric determination of pH arise from two sources. The first is caused by the change in electrode output at various temperatures. This interference can be controlled with instruments having temperature compensation or by calibrating the electrode-instrument system at the temperature of the samples. The second source of temperature effects is the change of pH due to changes in the sample as the temperature changes. This error is sample-dependent and cannot be controlled. It should, therefore, be noted by reporting both the pH and temperature at the time of analysis.

## 9.0 Procedure

### 9.1 Soil and Waste procedure:

#### 9.1.1 Calibration:

9.1.1.1 Place ON/OFF Switch to ON and MODE CONTROL to pH. Proceed with an Autocalibration.

##### 9.1.1.1.1 Autocalibration Procedure:

Select pH 4.01 and pH 7.00 buffer pair or pH 7.00 and pH 10.01 buffer pair depending upon the expected unknown pH. Place the electrode into the low buffer and press the CAL button. Wait for the READY LED then press ENTER. The display will freeze for 3 seconds then the cal2 LED will light indicating that the instrument is ready for the high buffer. Rinse the electrode and place it into the high buffer and wait for the READY LED to light. Press ENTER and wait for the SAMPLE LED to light. The instrument is now ready to measure sample pH.

##### 9.1.1.1.2 Manual Calibration:

Choose two buffers which will bracket the unknown pH. Place electrode into the first buffer and depress CAL. The CAL1 LED will light. Scroll the display to the correct buffer value using the arrow-up, arrow-down and x10 keys, then depress ENTER. The display will freeze for 3 seconds then the CAL2 LED will light,

indicating that it is ready for the second buffer. Place the electrode into the second buffer, wait for the READY LED to come on and then adjust the display to the correct buffer value. Depress ENTER and wait for the SAMPLE LED to come on. The meter is now ready to measure sample pH.

9.1.1.1.3 Check Slope:

Depress the SLOPE button. The value should be 80% to 110%. If not, an error of E21 will appear. Should the slope be out of range, check that the correct buffers were used and in the case of Manual Calibration that the correct buffer values were entered. For automatic calibration, the lowest buffer must be measured first and one of the two must be pH 7.00. If these measures fail, check the electrode.

9.1.1.2 The system must be calibrated at a minimum of two points that bracket the expected pH of the samples and are approximately three pH units or more apart. Repeat adjustments on successive portions of the two buffer solutions until readings are within 0.05 pH units of the buffer solution value.

9.1.2 Sample preparation and pH measurement of noncalcareous soils:

9.1.2.1 To 20 g of soil in a 50-mL beaker, add 20 mL of Type II water and stir the suspension several times during the next 30 min.

9.1.2.2 Let the soil suspension stand for about 1 hr to allow most of the suspended clay to settle out from the suspension.

9.1.2.3 Adjust the electrodes in the clamps of the electrode holder so that, upon lowering the electrodes into the beaker, the glass electrode will be immersed just deep enough into the clear supernatant solution to establish a good electrical contact through the ground-glass joint or the fiber-capillary hole. Insert the electrodes into the sample solution in this manner. For combination electrodes, immerse just below the suspension.

9.1.2.4 If the sample temperature differs by more than 2°C from the buffer solution, the measured pH values must be corrected.

9.1.2.5 Report the results as "soil pH measured in water."

9.1.3 Sample preparation and pH measurement of calcareous soils:

9.1.3.1 To 10 g of soil in a 50-mL beaker, add 20 mL of 0.01 M  $\text{CaCl}_2$  solution and stir the suspension several times during the next 30 min.

9.1.3.2 Let the soil suspension stand for about 30 min to allow most of the suspended clay to settle out from the suspension.

9.1.3.3 Adjust the electrodes in the clamps of the electrode holder so that, upon lowering the electrodes into the beaker, the glass electrode will be immersed well into the partly settled suspension and the calomel electrode will be immersed just deep enough into the clear supernatant solution to establish a good electrical contact through the ground-glass joint or the fiber-capillary hole. Insert the electrode into the sample solution in this manner.

9.1.3.4 If the sample temperature differs by more than  $2^\circ\text{C}$  from the buffer solution, the measured pH values must be corrected.

9.1.3.5 Report the results as "soil pH measured in 0.01 M  $\text{CaCl}_2$ ".

9.2 Liquid and water procedure:

9.2.1 Place the sample or buffer solution in a clean glass beaker using a sufficient volume to cover the sensing elements of the electrodes and to give adequate clearance for the magnetic stirring bar. If field measurements are being made, the electrodes may be immersed directly into the sample stream to an adequate depth and moved in a manner to ensure sufficient sample movement across the electrode-sensing element as indicated by drift-free readings ( $<0.1$  pH).

9.2.2 If the sample temperature differs by more than  $2^\circ\text{C}$  from the buffer solution, the measured pH values must be corrected.

9.2.3 Thoroughly rinse and gently wipe the electrodes prior to measuring pH of samples. Immerse the electrodes into the sample beaker or sample stream and gently stir at a constant rate to provide homogeneity and suspension of solids. Note and record sample pH and temperature. Repeat measurement on successive volumes of sample until values differ by  $<0.1$  pH units. Two or three volume changes are usually sufficient.

9.3 Use Log Entries:

9.3.1 All samples...include Date, Analyst, Sample No., Matrix, QC Batch, which buffer set used and result.

9.3.2 All QC...include Date, Analyst and Result. Use pH 5.00 when calibration was performed

with the 4.01 and 7.00 buffers. Use pH 8.00 buffer when calibration was performed with the 7.00 and 10.01 buffers.

## **10.0 Quality Control**

- 10.1 Duplicate samples and check standards should be analyzed routinely.
- 10.2 Electrodes must be thoroughly rinsed between samples. At least one known standard will be run and recorded with each batch to insure consistency. Use pH 5.00 when calibration was performed with the 4.01 and 7.00 buffers. Use pH 8.00 buffer when calibration was performed with the 7.00 and 10.01 buffers.

## **11.0 References**

- 11.1 Standard Methods for the Examination of Water and Wastewater, 16th Edition, p.525, 1985.

**APPENDIX D**  
**MATERIAL SAFETY DATA SHEETS**




**Gardner  
Denver**

# Material Safety Data Sheet

**H.M.I.S.**

 Health: 0  
 Flammability: 1  
 Reactivity: 0

These ratings should be used only as part of a full implemented H.M.I.S. program.

**Section I - Product Identification**

Trade Name and Synonyms <b>AEON PD</b>		Part Numbers: <b>28G23, 28G24, 28G25 and 28G28</b>	Health Emergency Phone Number <b>(217) 222-5400</b> Safety Department
Manufacturer's Name Gardner Denver Machinery Inc.			
Address 1800 Gardner Expressway - Quincy, IL 62301			
Product Identification Positive Displacement Blower Lubricant			Transport Emergency Phone Number <b>(800) 424-9300 (CHEMTREC)</b>
Chemical Names and Synonyms Syn. Hydrocarbons and additives	Use or Description: Gear Oil		

**Section II - Typical Chemical and Physical Properties**

Appearance: Lt. Amber Liquid	Viscosity: At 100°F, SUS 1020	At 40°C, cSt 220
Odor: Mild	Viscosity: At 210°F, SUS 111	At 100°C, cSt 23.0
Relative Density: Liquid 0.836 (H <sub>2</sub> O=1.0)      Vapor 35 (H <sub>2</sub> O=1.0)	Solubility in Water Negligible	PH: NA
Melting Point F(C): -30 to -10°F (-34 to -23°C)	Pour Point F(C): -35°F (-37°C)	
Boiling Point F(C): > 425°C	Flash Point F(C): ≥ 450°F (232°C) (ASTM D-92)	
Vapor Pressure-mm Hg 20C: < .1		

NA=Not Applicable

NE=Not Established

D=Decomposes

**Section III - Potentially Hazardous Ingredients**

Hazardous Ingredients: None
SEE SECTIONS XII AND XIII FOR REGULATORY AND FURTHER COMPOSITIONAL DATA.
Sources: A=ACGIH-TLV, A*=Suggested-TLV, O=OSHA, S=Supplier
NOTE: Limits shown for guidance only. Follow applicable regulations.

**Section IV - Health Hazard Data**

— INCLUDES AGGRAVATED MEDICAL CONDITIONS, IF ESTABLISHED —

EFFECTS OF OVEREXPOSURE: Not expected to be a problem.

**Section V - Emergency and First Aid Procedures**

<b>Eye Contact:</b>	Flush thoroughly with water. If irritation persists, call a physician.
<b>Skin Contact:</b>	Wash contact areas with soap and water. If irritation develops and persists, consult a physician.
<b>Inhalation:</b>	Remove from further exposure. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance and call a physician. If breathing has stopped, use mouth to mouth resuscitation.
<b>Ingestion:</b>	DO NOT INDUCE VOMITING. Immediately give 2 glasses of water. NEVER give anything by mouth to an unconscious person. Call a physician.

**Section VI - Fire and Explosion Hazard Data**

<b>Flash Point F(C):</b> ≥ 450°F (232°C) (ASTM D-92)	<b>Flammable Limits:</b> LEL: 1%	<b>Typical for Hydrocarbons:</b> UEL: 9%
<b>Extinguishing Media:</b> Water spray, foam, dry chemical, or CO <sub>2</sub>		
<b>Special Fire Fighting Procedures:</b> Water or foam may cause frothing. Use water to keep fire exposed containers cool. Water spray may be used to flush spills away from exposure.		
<b>Unusual Fire and Explosion Hazards:</b> Products of combustion may contain carbon monoxide, carbon dioxide and other toxic materials. DO NOT enter enclosed or confined space without proper protective equipment including respiratory protection.		
<b>NFPA Hazard ID:</b>	<b>Health: 0</b>	<b>Flammability: 1</b>
		<b>Reactivity: 0</b>

**Section VII - Reactivity Data**

<b>Stability (Thermal, Light, etc.):</b> Stable	<b>Conditions to Avoid:</b> Extreme heat
<b>Incompatibility (Materials to Avoid):</b> Strong oxidizers	
<b>Hazardous Decomposition Products:</b> Carbon monoxide	
<b>Hazardous Polymerization:</b> Will not occur	

**Section VIII - Spill or Leak Procedure****Environmental Impact:**

Report spills as required to appropriate authorities. U.S. Coast Guard regulations require immediate reporting of spills that could reach any waterway including intermittent dry creeks. Report spill to Coast Guard toll free number (800) 424-8802. In case of accident or road spill notify CHEMTREC (800) 424-9300.

**Procedures if Material is Released or Spilled:**

Absorb on fire retardant treated sawdust, diatomaceous earth, etc. Shovel up and dispose of at an appropriate waste disposal facility in accordance with current applicable laws and regulations, and product characteristics at time of disposal.

**Waste Management:**

Product is suitable for burning in an enclosed, controlled burner for fuel value or disposal by supervised incineration. Such burning may be limited pursuant to the Resource Conservation and Recovery Act. In addition, the product is suitable for processing by an approved recycling facility or can be disposed of at any government approved waste disposal facility. Use of these methods is subject to user compliance with applicable laws and regulations and consideration of product characteristics at time of disposal.

**Section IX - Special Protection Information****Eye Protection:**

Normal industrial eye protection practices should be employed.

**Skin Protection:**

No special equipment required. However, good personal hygiene practices should always be followed.

**Respiratory Protection:**

No special requirements under ordinary conditions of use and with adequate ventilation.

**Ventilation:**

Use in well ventilated area.

**Section X - Special Precautions****Handling:**

No special precautions required.

**Section XI - Toxicological Data****Acute Toxicological****Oral Toxicity (RATS):**

Expected to be Nontoxic -- Based on testing of similar products and/or the components.

**Dermal Toxicity (RABBITS):**

Expected to be Nontoxic -- Based on testing of similar products and/or the components.

**Inhalation Toxicity (RATS):**

Not established

**Eye Irritation (RABBITS):**

Expected to be non-irritating. -- Based on testing of similar products and/or the components.

**Skin Irritation (RABBITS):**

Expected to be non-irritating. -- Based on testing of similar products and/or the components.

## Section XII - Regulatory Information

### Governmental Inventory Status:

All components registered in accordance with TSCA.

D.O.T. Shipping Name: NA

D.O.T. Hazard Class: NA

### U.S. OSHA Hazard Communication Standard:

Product assessed in accordance with OSHA 29 CFR 1910.1200 and determined not to be hazardous.

### RCRA Information:

The unused product, in our opinion, is not specifically listed by the EPA as a hazardous waste (40 CFR, Part 261D), nor is it formulated to contain materials which are listed hazardous wastes. It does not exhibit the hazardous characteristics of ignitability, corrosivity, or reactivity and is not formulated with contaminants as determined by the Toxicity Characteristic Leaching Procedure (TCLP). However, used product may be regulated.

U.S. Superfund Amendments and Reauthorization Act (SARA) Title III:  
This product contains no "EXTREMELY HAZARDOUS SUBSTANCES".

### SARA (311/312 - Formerly 302) Reportable Hazard Categories:

None. This product contains no chemicals reportable under SARA (313) toxic release program.

The following product ingredients are cited on the lists below:

Chemical Name	CAS Number	List Citations
---------------	------------	----------------

--- No Reportable Ingredients ---

--- Key to List Citations ---

1 = OSHA Z	2 = ACGIH	3 = IRAC	4 = NTP	5 = NCI
6 = EPA CARC	7 = NFPA 49	8 = NFPA 325M	9 = DOT HMT	10 = CA RTK
11 = IL RTK	12 = MA RTK	13 = MN RTK	14 = NJ RTK	15 = MI 283
16 = FL RTK	17 = PA RTK	18 = CA P65		

-- NTP, IARC, AND OSHA include Carcinogenic Listings --

Note: AEON Lubricants are not formulated to contain PCBs.

## Section XIII - Ingredients

INGREDIENT DESCRIPTION	PERCENT	CAS NUMBER
Contains the following base oils:	> 95.00	
1-Decene, Homopolymer, Hydrogenated		68037-01-4
Hexanedioic Acid, Ditridecyl Ester		16958-92-2

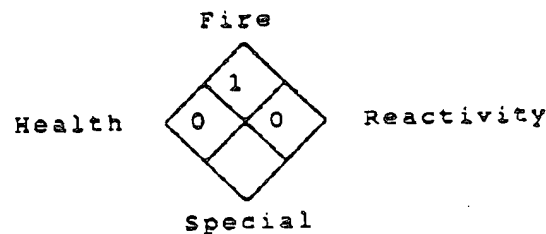
# W I T C O   M A T E R I A L   S A F E T Y   D A T A   S H E E T

LubriMatic 11315

PAGE 1

Product Code: 11315

**NFPA HAZARD RATING**  
 4 - Extreme  
 3 - High  
 2 - Moderate  
 1 - Slight  
 0 - Insignificant



## DIVISION AND LOCATION---SECTION I

Division: LUBRIMATIC

Location: OLATHE

1400 S. HARRISON, OLATHE, KS, 66061

Emergency Telephone Number: (913) 782-5800

Transportation Emergency: CHEMTREC 1-(800) 424-9300 (U.S. and Canada)

## CHEMICAL AND PHYSICAL PROPERTIES---SECTION II

Chemical Name:

petroleum hydrocarbon plus additives

Formula: not applicable

Hazardous Decomposition Products:

oxides of barium

oxides of antimony

carbon monoxide and carbon dioxide from burning.

zinc oxide

sulfur dioxide or hydrogen sulfide, depending upon decomposition conditions

oxides of phosphorous from burning

oxides of sulfur

hydrochloric acid on burning or decomposition

Incompatibility (Keep away from):

strong oxidizers such as hydrogen peroxide, bromine, and chromic acid.

Toxic and Hazardous Ingredients:

none

Form: semi-solid

Odor: mineral oil

Appearance: grease

Color: black

Specific Gravity (water=1): @ room temperature .935

Boiling Point: no data available

Melting Point: not applicable

Solubility in Water (by weight %): negligible at 25°C

Volatile (by weight %): not applicable

Evaporation Rate: not applicable

Vapor Pressure (mm Hg at 20°C): not applicable

Vapor Density (air=1): not applicable

pH (as is): not applicable

Stability: Product is stable under normal conditions

Viscosity SUS at 100°F: Greater than or = to 100

(Continued on next page)

LubriMatic 11315

Product Code: 11315

FIRE AND EXPLOSION DATA---SECTION III

Special Fire Fighting Procedures:

Dense smoke. Fire fighters should wear an approved self-contained breathing apparatus.

Do not use water except as fog

Unusual Fire and Explosion Hazards:

dense smoke.

Flashpoint: (Method Used) Cleveland open cup greater than 160°C (320°F)

Flammable limits %: no data available

Extinguishing agents:

Drychemical or Waterfog or CO<sub>2</sub> or Foam or Sand/Earth

Water may cause frothing.

Closed containers exposed to fire may be cooled with water.

HEALTH HAZARD DATA---SECTION IV

Permissible concentrations (air):

not applicable

Chronic effects of overexposure:

None when used with good personal hygiene practices. May otherwise cause skin and eye irritation upon prolonged or repeated contact.

Acute toxicological properties:

no data available

Emergency First Aid Procedures:

Eyes: Immediately flush with large quantities of water for at least 15 minutes and call a physician.

Skin Contact: Remove excess with cloth or paper and wash area thoroughly with soap and water. For high pressure injection under the skin see a physician immediately.

Inhalation: Remove exposed person to fresh air if discomfort is experienced while handling hot product.

If Swallowed: Contact a physician immediately.

ADVICE TO PHYSICIANS:

High velocity injection under the skin may result in serious injury. If left untreated the affected area is subject to infection, disfigurement, lack of blood circulation and may require amputation. When dispensed by high pressure equipment this material can easily penetrate the skin and leave a bloodless puncture wound. Material injected into a finger can be deposited into the palm of the hand. Within 24-48 hours the patient may experience swelling, discoloration, and throbbing pain in the affected area. Immediate treatment by a surgical specialist is recommended.

(Continued on next page)

LubriMatic 11315

Product Code: 11315

SPECIAL PROTECTION INFORMATION---SECTION V

Ventilation Type Required (Local, mechanical, special):

none

Respiratory Protection (Specify type):

none

Protective Gloves:

none

Eye Protection:

chemical safety goggles and, if handled hot, full face shield

Other Protective Equipment:

none

HANDLING OF SPILLS OR LEAKS---SECTION VI

Procedures for Clean-Up:

Transfer bulk of mixture into another container. Absorb residue with an inert material such as earth, sand, or vermiculite. Sweep up and dispose as solid waste in accordance with local, state, and federal regulations.

Waste Disposal:

Dispose of in accordance with all applicable federal, state and local regulations.

SPECIAL PRECAUTIONS---SECTION VII

Precautions to be taken in handling and storage:

Keep container closed until ready for use.

TRANSPORTATION DATA---SECTION VIII

D.O.T.: Not Regulated

Reportable Quantity: not applicable

Freight Classification: Petroleum Lubricating Grease

Special Transportation Notes:

not applicable

ENVIRONMENTAL/SAFETY REGULATIONS---SECTION IX

Section 313 (Title III Superfund Amendment and Reauthorization Act):

This product does not contain any chemical in sufficient quantity to be subject to reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.

(Continued on next page)

## WITCO MATERIAL SAFETY DATA SHEET

LubriMatic 11315

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Product Code: 11315

## COMMENTS

KEEP OUT OF REACH OF CHILDREN!!!

\*\*\*\* STATE RIGHT TO KNOW INFORMATION \*\*\*\*

New Jersey - petroleum oil(grease)

Penn. - formula trade secret

Prepared by: RAY D LAWSONTitle: MGR., TECH. COMPLIANCEOriginal Date: Sent to:Revision Date: 07/16/96Supersedes : 04/06/94Date Sent :

We believe the statements, technical information and recommendations contained herein are reliable, but they are given without warranty or guarantee of any kind, express or implied, and we assume no responsibility for any loss, damage, or expense, direct or consequential, arising out of their use.





Du Pont Chemicals

2008FR

Revised 27-Jun-91

Printed 03-Jul-91



## MATERIAL IDENTIFICATION

Corporate Number DU000025

"FREON" is a registered trademark of Du Pont.

Manufacturer/Distributor Du Pont  
1007 Market Street  
Wilmington, DE 19898

Phone Numbers	Product Information	1-800-441-9450
	Transport Emergency	CHEMTREC: 1-800-424-9300
	Medical Emergency	1-800-441-3637

Chemical Family HALOGENATED HYDROCARBON

Du Pont Registry Number DP31-32-7

Formula CHClF2

Molecular Weight 86.47

TSCA Inventory Status Reported/Included

NPCA-HMIS Ratings

Health:	1
Flammability:	0
Reactivity:	1

Personal Protection rating to be supplied by user depending on use conditions.

## COMPONENTS

Material	CAS Number	Percent
METHANE, CHLORODIFLUORO- ("FREON" 22)	75-45-6	100

## PHYSICAL DATA

Boiling Point -40.8°C (-41.4°F)

Vapor Pressure 151 psig at 25 deg C (77 deg F)

(continued)

## PHYSICAL DATA (continued)

Vapor Density	(Air = 1.0) 3.03 at 25 deg C (77 deg F)
% Volatiles	100 WT %
Evaporation Rate	>1 (CCl4 = 1.0)
Water Solubility	0.30 WT % at 25°C (77°F)
pH	Neutral
Odor	Slight ethereal
Form	Liquefied gas
Color	Colorless
Density	1.194 g/cc at 25 deg C (77 deg F) - Liquid
Appearance	: Clear

## HAZARDOUS REACTIVITY

Instability	Material is stable. However, avoid open flames and high temperatures.
Incompatibility	Incompatible with alkali or alkaline earth metals- powdered Al, Zn, Be, etc.
Polymerization	Polymerization will not occur.
Decomposition	: Decomposition products are hazardous. "FREON" 22 can be decomposed by high temperatures (open flames, glowing metal surfaces, etc.) forming hydrochloric and hydrofluoric acids-possibly carbonyl halides.

## FIRE AND EXPLOSION DATA

Flash Point	None
Method	TOC
Autodecomposition	632°C (1170°F)

Other burning material may cause chlorodifluoromethane to burn weakly. Use water spray or fog to cool containers. Cylinders are equipped with pressure and temperature relief devices but may rupture under fire conditions. Decomposition may occur.

Chlorodifluoromethane is not flammable at ambient temperatures and atmospheric pressure. However, chlorodifluoromethane has been shown in tests to be combustible at pressures as low as 60 psig at ambient temperature when mixed with air at concentrations of 65 volume % air.

(continued)

37 84728 12134 2 000 000 0000

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## FIRE AND EXPLOSION DATA (continued)

Fire and Explosion Hazards	No Information Available.
Extinguishing Media	As appropriate for combustibles in area. Extinguishant for other burning material in area is sufficient to stop burning.
Special Fire Fighting Instructions	Self-contained breathing apparatus (SCBA) is required if cylinders rupture or contents are released under fire conditions.

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## HEALTH HAZARD INFORMATION

### PRINCIPAL HEALTH HAZARDS (Including Significant Routes, Effects, Symptoms of Overexposure, and Medical Conditions Aggravated by Exposure)

Inhalation of high concentrations of vapor is harmful and may cause heart irregularities, unconsciousness or death. Intentional misuse or deliberate inhalation may cause death without warning. Vapor reduces oxygen available for breathing and is heavier than air. Liquid contact can cause frostbite.

### ANIMAL DATA:

Inhalation 4-hour LC50: 220,000 ppm in rats

The compound is untested for skin and eye irritancy, and is untested for animal sensitization. Toxicity described in animals exposed by inhalation to concentrations ranging from 5% to 70% include effects on the central nervous system, liver, lungs, kidneys, spleen; cardiac sensitization; decreased body weight gain; and partial anesthesia. In chronic inhalation studies FC-22 produced a small, but statistically significant, increase of tumors in male rats, but not female rats or male or female mice at a concentration of 50,000 ppm (v/v). In the same studies, no carcinogenic effects were seen in either species at concentrations of 10,000 ppm or 1000 ppm (v/v). FC-22 was mutagenic in bacterial cell cultures but not mammalian cell cultures, and was not mutagenic in whole animal assays. A slight, but significant, increase in developmental toxicity (eye malformations, decreased fetal weights) has been observed in the offspring of rats exposed to high concentrations (50,000 ppm) of FC-22, a concentration which was also maternally toxic; no effects on the fetus or the maternal rats were seen at 1000 or 100 ppm. Developmental toxicity studies in rabbits at 50,000, 1000 and 100 ppm FC-22 were negative. Based on these findings, FC-22 is not considered a unique hazard to the conceptus and poses no carcinogenic hazard when exposures are below the TLV. Studies of the effects of FC-22 on male reproductive performance have been negative. Specific studies to evaluate the effect on female reproductive performance have not been conducted, however, limited information obtained from studies on developmental toxicity do not indicate adverse effects on female reproductive performance at concentrations up to 50,000 ppm (v/v).

(continued)

## HEALTH HAZARD INFORMATION (continued)

### HUMAN HEALTH EFFECTS:

Overexposure to the vapors by inhalation may include temporary nervous system depression with anesthetic effects such as dizziness, headache, confusion, incoordination, and loss of consciousness. Higher exposures to the vapors may cause temporary alteration of the heart's electrical activity with irregular pulse, palpitations, or inadequate circulation; or fatality from gross overexposure. Skin contact with the liquid may cause frostbite.

Individuals with preexisting diseases of the central nervous or cardiovascular system may have increased susceptibility to the toxicity of excessive exposures. There are no reports of human sensitization.

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<b>Carcinogenicity</b>	None of the components in this material is listed by IARC, NTP, OSHA, or ACGIH as a carcinogen.
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### # Applicable Exposure Limits

METHANE, CHLORODIFLUORO- ("FREON" 22)	
AEL * (Du Pont)	None Established
TLV (ACGIH)	1,000 ppm, 3,540 mg/m <sup>3</sup> - 8 Hr TWA
PEL (OSHA)	1,000 ppm, 3,500 mg/m <sup>3</sup> - 8 Hr TWA

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\* AEL is Du Pont's Acceptable Exposure Limit.

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<b>Safety Precautions</b>	Avoid breathing vapors and liquid contact with skin or eyes. Use with sufficient ventilation to keep employee exposures below recommended limits.
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"FREON" 22 should not be mixed with air for leak testing. In general, it should not be used or allowed to be present with high concentrations of air above atmospheric pressure.

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## FIRST AID

### INHALATION

If large concentrations are inhaled, immediately remove to fresh air. Keep persons calm. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

### SKIN CONTACT

In case of skin contact, flush with water for 15 minutes. Treat for frostbite if necessary by gently warming affected area.

### EYE CONTACT

In case of eye contact, immediately flush eyes with plenty of water for 15 minutes. Call a physician.

### IF SWALLOWED

Ingestion is not considered a potential route of exposure.

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(continued)

## PROTECTION INFORMATION

### Generally Applicable Control Measures and Precautions

Normal ventilation for standard manufacturing procedures is generally adequate. Local exhaust should be used when large amounts are released. Mechanical ventilation should be used in low places.

### Personal Protective Equipment

Impervious gloves and chemical splash goggles should be used when handling liquid. Under normal manufacturing conditions, no respiratory protection is required when using this product. Self-contained breathing apparatus (SCBA) is required if a large release occurs.

## DISPOSAL INFORMATION

### Spill, Leak, or Release

NOTE: Review FIRE AND EXPLOSION HAZARDS and SAFETY PRECAUTIONS before proceeding with clean up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean up.

Ventilate area—especially low places where heavy vapors might collect. Remove open flames. Use self-contained breathing apparatus (SCBA) for large spills or releases.

### Waste Disposal

Reclaim by distillation. Comply with Federal, State and local regulations.

## SHIPPING INFORMATION

### DOT

Proper Shipping Name	CHLORODIFLUOROMETHANE
Hazard Class	NONFLAMMABLE GAS
UN/NA No.	UN 1018
DOT Labels(s)	NONFLAMMABLE GAS
DOT Placard	NONFLAMMABLE GAS

### DOT/IMO

Proper Shipping Name	CHLORODIFLUOROMETHANE
Hazard Class	NONFLAMMABLE GAS 2.2
UN No.	1018
DOT/IMO Label	NONFLAMMABLE GAS
Shipping Containers	Tank Car Tank Truck Cylinders

(continued)

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## STORAGE CONDITIONS

Clean, dry area. Do not heat above 125 deg F (52 deg C).

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## TITLE III HAZARD CLASSIFICATIONS

Acute	Yes
Chronic	No
Fire	No
Reactivity	No
Pressure	Yes

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### LISTS:

Extremely Hazardous Substance	-No
CERCLA Hazardous Substance	-No
Toxic Chemicals	-Yes

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The data in this Material Safety Data Sheet relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process.

Responsibility for MSDS:

W. J. Brock  
Du Pont Chemicals  
P. O. Box 80709, Chestnut Run  
Wilmington, DE 19880-0709  
302-999-5072

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# Indicates updated section.

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End of MSDS



Du Pont Chemicals

6002FR



Revised 12-MAR-1994

Printed 25-JAN-1995

## "SUVA" HP62

### CHEMICAL PRODUCT/COMPANY IDENTIFICATION

#### Material Identification

"SUVA" is a registered trademark of DuPont.

Corporate MSDS Number DU005612

#### Company Identification

MANUFACTURER/DISTRIBUTOR

DuPont  
1007 Market Street  
Wilmington, DE 19898

#### PHONE NUMBERS

Product Information 1-800-441-9442  
Transport Emergency CHEMTREC: 1-800-424-9300  
Medical Emergency 1-800-441-3637

### COMPOSITION/INFORMATION ON INGREDIENTS

#### Components Material

CAS Number %

PENTAFLUOROETHANE (HFC-125) 354-33-6 44

ETHANE, 1,1,1-TRIFLUORO- (HFC-143a) 420-46-2 52

811-97-2

ETHANE, 1,1,1,2-TETRAFLUORO- (HFC-134a) 4

### HAZARDS IDENTIFICATION

#### # Potential Health Effects

Inhalation of high concentrations of vapor is harmful and may cause heart irregularities, unconsciousness, or death. Intentional misuse or deliberate inhalation may cause death without warning. Vapor reduces oxygen available for breathing and is heavier than air. Liquid contact can cause

(Continued)

## HAZARDS IDENTIFICATION(Continued)

frostbite.

### HUMAN HEALTH EFFECTS:

Overexposure to the vapors by inhalation may include temporary nervous system depression with anesthetic effects such as dizziness, headache, confusion, incoordination, and loss of consciousness. Higher exposures to the vapors may cause temporary alteration of the heart's electrical activity with irregular pulse, palpitations, or inadequate circulation; or fatality from gross overexposure. Contact with the liquid may cause frostbite.

Individuals with preexisting diseases of the central nervous or cardiovascular system may have increased susceptibility to the toxicity of increased exposures.

### Carcinogenicity Information

None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, OSHA or ACGIH as a carcinogen.

## FIRST AID MEASURES

### First Aid:

#### INHALATION

If inhaled, immediately remove to fresh air. Keep person calm. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

#### SKIN CONTACT

Flush area with lukewarm water. Do not use hot water. If frostbite has occurred, call a physician.

#### EYE CONTACT

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

#### INGESTION

Not a probable route. However, in case of accidental ingestion, call a physician.

### Notes to Physicians

THIS MATERIAL MAY MAKE THE HEART MORE SUSCEPTIBLE TO ARRHYTHMIAS. Catecholamines such as adrenaline, and other compounds having similar effects, should be reserved for emergencies and then used only with special caution.

(Continued)



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## FIRE FIGHTING MEASURES

### Flammable Properties

Flash Point	Will not burn
Method	TOC
Flammable limits in Air, % by Volume	
LEL	Not applicable
UEL	Not applicable
Autoignition	Not determined

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### Fire and Explosion Hazards:

Cylinders may rupture under fire conditions. Decomposition may occur.

### Potential Combustibility:

"SUVA" HP62 is not flammable at temperatures up to 80 deg C (176 deg F) and at atmospheric pressure. Data are not available at higher temperatures and pressures. However, one of the components, HFC-143a is flammable. Another, HFC-134a, has been shown in tests to be combustible at pressures as low as 60 psig at ambient temperature when mixed with air at concentrations of 65 volume % air. Therefore, "SUVA" HP62 should not be mixed with air for leak testing. In general, it should not be used or allowed to be present with high concentrations of air above atmospheric pressure. Experimental data have also been reported which indicate combustibility of HFC-134a in the presence of certain concentrations of chlorine.

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### Extinguishing Media

As appropriate for combustibles in area.

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### Fire Fighting Instructions

Cool cylinder with water spray or fog. Self-contained breathing apparatus (SCBA) is required if cylinders rupture and contents are released under fire conditions.

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## ACCIDENTAL RELEASE MEASURES

### Safeguards (Personnel)

NOTE: Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.

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### Accidental Release Measures

Ventilate area, especially low or enclosed places where heavy vapors might collect. Remove open flames. Use self-contained breathing apparatus (SCBA) for large spills or releases.

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(Continued)

## **HANDLING AND STORAGE**

### **Handling (Personnel)**

Avoid breathing vapor. Avoid liquid contact with eyes and skin. Use with sufficient ventilation to keep employee exposure below recommended limits. Contact with chlorine or other strong oxidizing agents should also be avoided. See Fire and Explosion Data section.

### **Storage**

Clean, dry area. Do not heat above 52 deg C (125 deg F).

## **EXPOSURE CONTROLS/PERSONAL PROTECTION**

### **Engineering Controls**

Avoid breathing vapors. Avoid contact with skin or eyes. Use with sufficient ventilation to keep employee exposure below the recommended exposure limit. Local exhaust should be used if large amounts are released. Mechanical ventilation should be used in low or enclosed places.

### **Personal Protective Equipment**

Impervious gloves should be used to avoid prolonged or repeated exposure. Chemical splash goggles should be available for use as needed to prevent eye contact. Under normal manufacturing conditions, no respiratory protection is required when using this product. Self-contained breathing apparatus (SCBA) is required if a large release occurs.

### **Exposure Guidelines**

#### **Applicable Exposure Limits**

##### **PENTAFLUOROETHANE (HFC-125)**

PEL (OSHA)	None Established
TLV (ACGIH)	None Established
AEL * (Du Pont)	1000 ppm, 8 & 12 Hr. TWA

##### **ETHANE, 1,1,1-TRIFLUORO- (HFC-143a)**

PEL (OSHA)	None Established
TLV (ACGIH)	None Established
AEL * (Du Pont)	1000 ppm, 8 & 12 Hr. TWA

##### **ETHANE, 1,1,1,2-TETRAFLUORO- (HFC 134a)**

PEL (OSHA)	None Established
TLV (ACGIH)	None Established
AEL * (Du Pont)	1000 ppm, 8 & 12 Hr. TWA
WEEL (AIHA)	1000 ppm, 8 Hr. TWA

\* AEL is Du Pont's Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence.

(Continued)

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**PHYSICAL AND CHEMICAL PROPERTIES**

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**Physical Data**

Boiling Point	-46.7 C (-52.1 F) Average
Vapor Pressure	182.1 psia at 25 deg C (77 deg F)
% Volatiles	100 WT%
Evaporation Rate	(CL4 = 1)
	Greater than 1
Solubility in Water	Not determined
Odor	Slight ethereal
Form	Liquefied gas
Color	Clear, colorless
Specific Gravity	1.05 @ 25C (77F)

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**STABILITY AND REACTIVITY**

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**Chemical Stability**

Material is stable. However, avoid open flames and high temperatures.

**Incompatibility with Other Materials**

Incompatible with active metals, alkali or alkaline earth metals--powdered Al, Zn, Be, etc.

**Decomposition**

Decomposition products are hazardous. This material can be decomposed by high temperatures (open flames, glowing metal surfaces, etc.) forming hydrofluoric acid and possibly carbonyl fluoride.

**Polymerization**

Polymerization will not occur.

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**TOXICOLOGICAL INFORMATION**

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**Animal Data**

The blend is untested.

HFC-125

Inhalation 4 hour ALC: > 709,000 ppm in rats

Single, high inhalation exposures caused lethargy, decreased activity, labored breathing and weight loss. Weak cardiac sensitization effect, a potentially fatal disturbance of heart rhythm caused by a heightened sensitivity to the action of epinephrine.

No animal data are available to define carcinogenic, developmental or reproductive hazards. In animal testing this material has not caused developmental toxicity. HFC-125 does not produce genetic damage in bacterial or mammalian cell cultures or when tested in animals (not tested for heritable genetic damage).

(Continued)

## TOXICOLOGICAL INFORMATION (Continued)

### HFC-134a

Inhalation 4-hour LC50: 567,000 ppm in rats

A 5 or 10 second spray of vapor produced very slight eye irritation and a 24-hour occlusive application produced slight skin irritation in rabbits. The compound is not a skin sensitizer in animals. No toxic effects were seen in animals from exposures by inhalation to concentrations up to 81,000 ppm. Lethargy and rapid respiration were observed at a vapor concentration of 305,000 ppm and pulmonary congestion, edema, and central nervous system effects occurred at a vapor concentration of 750,000 ppm. Cardiac sensitization occurred in dogs at 75,000 ppm following an epinephrine challenge. No effects in animals occurred from repeated inhalation exposures to 99,000 ppm for two weeks or up to 50,000 ppm for three months. Repeated exposures to higher concentrations caused transient tremors, incoordination and some organ weight changes. Long-term exposures produced increased testes weights and increased urinary fluoride levels. No adverse effects were observed in male and female rats fed diets containing 300 mg/kg/day of HFC-134a for 52 weeks. Animal testing indicates that this compound does not have carcinogenic or mutagenic effects. Inhalation of 50,000 ppm for two years caused an increase in benign testicular tumors in male rats. No effects were observed at lower concentrations. The tumors were late-occurring and were judged not to be life-threatening. Embryotoxic activity has been observed in some animal tests but only at high concentrations that were also maternally toxic.

### HFC-143a

Inhalation 4-hour LC50: >540,000 ppm in rats

Single exposures by inhalation to 500,000 ppm caused anesthesia but no mortality at 540,000 ppm. Cardiac sensitization occurred in dogs at 300,000 ppm following an intravenous challenge with epinephrine. Two, 4-week inhalation have been conducted. In the first study, pathological changes in the testes were observed at all exposure concentrations; no effects were observed in females. The testicular effect was considered related to the method used to expose the rats to HFC-143a. In the second study using the same exposure concentrations, no effects were noted in males at any concentration. Data from a 90-day study revealed no effects in male or female rats at exposures up to 40,000 ppm. Long-term exposure caused significantly decreased body weights in male rats fed 300 mg/kg for 52 weeks, but there was no effect on mortality. Tests in rats demonstrated no carcinogenic activity when administered orally 300 mg/kg/day for 52 weeks and observed

(Continued)

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**TOXICOLOGICAL INFORMATION**(Continued)

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for an additional 73 weeks. Tests in bacterial cell cultures demonstrated mutagenic activity, but the compound did not induce transformation of mammalian cells in culture or in the whole animal. Tests in animals demonstrate no developmental toxicity.

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**ECOLOGICAL INFORMATION**

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**Ecotoxicological Information**  
**Aquatic Toxicity**

HFC 143a  
96-hour LC50, rainbow trout: >40 mg/L

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**DISPOSAL CONSIDERATIONS**

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**Waste Disposal**

Comply with Federal, State, and local regulations. Reclaim by distillation or remove to a permitted waste disposal facility.

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**TRANSPORTATION INFORMATION**

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**Shipping Information**

DOT/IMO

Proper Shipping Name

LIQUIFIED GAS, N.O.S.  
(CONTAINS PENTAFLUOROETHANE AND  
TETRAFLUOROETHANE)

Hazard Class

2.2

UN No.

1956

DOT/IMO Label

NONFLAMMABLE GAS

Shipping Containers

Tank Cars.

Cylinders

Ton Tanks

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**REGULATORY INFORMATION**

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**U.S. Federal Regulations**

TSCA Inventory Status

Reported/Included.

TITLE III HAZARD CLASSIFICATIONS SECTIONS 311, 312

Acute : No  
Chronic : No

(Continued)

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## REGULATORY INFORMATION (Continued)

Fire : No  
Reactivity : No  
Pressure : Yes

### LISTS:

SARA Extremely Hazardous Substance	-No
CERCLA Hazardous Material	-No
SARA Toxic Chemicals	-No

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## OTHER INFORMATION

### NFPA, NPCA-HMIS

#### NPCA-HMIS Rating

Health	1
Flammability	0
Reactivity	1

Personal Protection rating to be supplied by user depending on use conditions.

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### Additional Information

HFC-125 and HFC-143a are TSCA listed, and are controlled by a TSCA Section 5 Consent Order.

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The data in this Material Safety Data Sheet relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process.

Responsibility for MSDS	DuPont Chemicals
Address	Engineering & Product Safety P. O. Box 80709, Chestnut Run Wilmington, DE 19880-0709
Telephone	302-999-4946

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# Indicates updated section.

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End of MSDS

10-190 p.1/2

**WELD-ON****MATERIAL SAFETY DATA SHEET**DATE PREPARED  
OR REVISED: NOV. 1990

Information on this form is furnished solely for the purpose of compliance with the Occupational Safety and Health Act and shall not be used for any other purpose. IPS Corporation urges the customers receiving this Material Safety Data Sheet to study it carefully to become aware of the hazards, if any, of the product involved. In the interest of safety, you should notify your employees, agents, and contractors of the information on this sheet.

**SECTION I****MANUFACTURER'S NAME**

IPS Corporation

**ADDRESS**

17109 S. Main St., P.O. Box 379, Gardena, CA 90248

**TRANSPORTATION EMERGENCIES**

CHEMTREC: (800) 424-9300

Medical Emergencies: (213) 484-5151

(LA. Poison Center 24 Hr. No.)

Business: (213) 321-6515

**CHEMICAL NAME AND FAMILY**

Primer for PVC and CPVC

Mixture of Organic Solvents

**TRADE NAME**

Weld-On P-70 Primer for PVC and CPVC Plastic Pipe

FORMULA Proprietary

**SECTION II - HAZARDOUS INGREDIENTS**NONE OF THE INGREDIENTS BELOW ARE LISTED AS CARCINOGENS  
BY IARC, NTP, OSHA**CAS #****APPROX %****ACGIH-TLV****OSHA-PEL**

Tetrahydrofuran (THF)

109-99-9

45-55

200 ppm

200 ppm

Methyl Ethyl Ketone (MEK)

78-93-3

47\*

200 ppm

200 ppm

Cyclohexanone

108-94-1

5-15

25 ppm  
Skin

50 ppm

\*Title III Section 313 Supplier Notification: This product contains toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-To-Know Act of 1986 and of 40CFR372. This information must be included in all MSDS's that are copied and distributed for this material.

**SHIPPING INFORMATION**

DOT HAZARD CLASS: FLAMMABLE LIQUID

DOT SHIPPING NAME: CEMENT FLAMMABLE LIQUID

IDENTIFICATION NUMBER: UN/NA 1133

**SPECIAL HAZARD DESIGNATIONS**

	HMIS	NFPA	HAZARD RATING
HEALTH:	2	2	0 - MINIMAL
FLAMMABILITY:	3	3	1 - SLIGHT
REACTIVITY:	0	1	2 - MODERATE
PROTECTIVE EQUIPMENT:	H	—	3 - SERIOUS
			4 - SEVERE

**SECTION III - PHYSICAL DATA****APPEARANCE**

Clear or Purple thin liquid

**ODOR**

Ethereal

**BOILING POINT (°F/°C)**151°F based on first boiling  
component THF**SPECIFIC GRAVITY @ 73±2°F**

Typical 0.870 ± 0.01

**VAPOR PRESSURE (mm Hg.)**143 mm Hg. based on first boiling  
component, THF @ 20°C**PERCENT, VOLATILE BY VOLUME (%)**

100%

**VAPOR DENSITY (Air = 1)**

2.49

**EVAPORATION RATE (BUAC = 1)**

Approx. 5-8

**SOLUBILITY IN WATER**

Completely soluble in water

VOC STATEMENT: This cement contains 850 grams of VOC per liter as manufactured. More than 60 percent of the VOC acts as a reactive diluent and remains in the pipe joint.

**SECTION IV - FIRE AND EXPLOSION HAZARD DATA****FLASH POINT**

T.C.C. 6°F Based on THF

**FLAMMABLE LIMITS  
(PERCENT BY VOLUME)****LEL**

1.8

**UEL**

11.8

**FIRE EXTINGUISHING MEDIA**

Ansul "Purple K" potassium bicarbonate dry chemical, carbon dioxide, National Aer-O-Foam universal alcohol resistant foam, water spray.

**SPECIAL FIRE FIGHTING PROCEDURES**

Evacuate enclosed areas, stay upwind. Close or confined quarters require self-contained breathing apparatus, positive pressure hose masks or airline masks. Use water spray to cool containers, to flush spills from source of ignition and to disperse vapors.

**UNUSUAL FIRE AND EXPLOSION HAZARDS**

Fire hazard because of low flash point and high volatility. Vapors are heavier than air and may travel to source of ignition.

SECTION V - HEALTH HAZARD DATA

PRIMARY ROUTES OF ENTRY:

☒ Inhalation    ☒ Skin Contact    ☐ Eye Contact    ☐ Ingestion

EFFECT OF OVEREXPOSURE

**ACUTE:** Inhalation: Severe overexposure may result in nausea, dizziness, headache. Can cause drowsiness, irritation of eyes and nasal passages. Skin Contact: Skin irritant. Liquid contact may remove natural skin oils resulting in skin irritation. Dermatitis may occur with prolonged contact. Skin Absorption: Prolonged or widespread exposure may result in the absorption of harmful amounts of material. Eye Contact: Overexposure may result in severe eye injury with corneal or conjunctival inflammation on contact with the liquid. Vapors slightly uncomfortable. Ingestion: Moderately toxic. May cause nausea, vomiting, diarrhea. May cause mental sluggishness.

**CHRONIC:** None currently known.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

None currently known.

EMERGENCY AND FIRST AID PROCEDURES

Inhalation: If overcome by vapors, remove to fresh air and if breathing stopped, give artificial respiration — preferably mouth-to-mouth. If breathing is difficult, give oxygen. Call physician.

Eye Contact: Flush eyes with plenty of water for 15 mins. and call a physician.

Skin Contact: Remove contaminated clothing and shoes. Wash skin with plenty of soap and water for at least 15 mins. If irritation develops, get medical attention.

Ingestion: Give 1 or 2 glasses of water or milk. Do not induce vomiting. Call physician or poison control center immediately.

SECTION VI - REACTIVITY DATA

STABILITY

UNSTABLE

STABLE

CONDITIONS TO AVOID

Keep away from heat, sparks, open flame and other sources of ignition.

X

INCOMPATIBILITY (MATERIALS TO AVOID)

Caustics, ammonia, inorganic acids, chlorinated compounds, strong oxidizers and isocyanates.

HAZARDOUS DECOMPOSITION PRODUCTS

When forced to burn, this product gives out carbon monoxide, carbon dioxide, toxic fumes and smoke.

HAZARDOUS POLYMERIZATION

MAY OCCUR

WILL NOT OCCUR

CONDITIONS TO AVOID

Keep away from heat, sparks, open flame and other sources of ignition.

X

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Eliminate all ignition sources. Avoid breathing of vapors. Keep liquid out of eyes. Flush with large amount of water. Contain liquid with sand or earth. Absorb with sand or nonflammable absorbent material and transfer into steel drums for recovery or disposal. Prevent liquid from entering drains.

WASTE DISPOSAL METHOD

Follow local, State and Federal regulations. Consult disposal expert. Can be disposed of by incineration. Excessive quantities should not be permitted to enter drains. Empty containers should be air dried before disposing. Hazardous Waste Code: 214

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type)

In situations where vapor concentrations exceed the recommended exposure limits, a NIOSH-approved organic vapor cartridge respirator with full face-piece is recommended. Use only SCBA for emergencies.

VENTILATION

Explosion-proof general mechanical ventilation or local exhaust is recommended to maintain vapor concentrations below recommended exposure limits.

PROTECTIVE GLOVES

PVA coated

EYE PROTECTION

Splashproof chemical goggles

OTHER PROTECTIVE EQUIPMENT AND HYGIENIC PRACTICES

Impervious apron and a source of running water to flush or wash the eyes and skin in case of contact.

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Store in the shade between 40°F-110°F. Keep away from heat, sparks, open flame and other sources of ignition. Avoid prolonged breathing of vapor. Use with adequate ventilation. Avoid contact with eyes, skin and clothing. Train employees on all special handling procedures before they work with this product.

OTHER PRECAUTIONS

Follow all precautionary information given on container label, product bulletins and our solvent cementing literature. All handling equipment should be electrically grounded.

The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof.

Prepared by: George Blanco of IPS  
e



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MATERIAL SAFETY DATA SHEET

DATE PREPARED  
OR REVISED: NOV. 1990

Information on this form is furnished solely for the purpose of compliance with the Occupational Safety and Health Act and shall not be used for any other purpose. IPS Corporation urges the customers receiving this Material Safety Data Sheet to study it carefully to become aware of the hazards, if any, of the product involved. In the interest of safety, you should notify your employees, agents, and contractors of the information on this sheet.

SECTION I

MANUFACTURER'S NAME IPS Corporation		TRANSPORTATION EMERGENCIES: CHEMTREC: (800) 424-9300 Medical Emergencies: (213) 484-5151 (LA. Poison Center 24 Hr. No.) Business: (213) 321-6515
ADDRESS 17109 S. Main St., P.O. Box 379, Gardena, CA 90248		
CHEMICAL NAME AND FAMILY Primer for PVC and CPVC Mixture of Organic Solvents		TRADE NAME Weld-On P-68 Primer for PVC and CPVC Plastic Pipe FORMULA Proprietary

SECTION II - HAZARDOUS INGREDIENTS

NONE OF THE INGREDIENTS BELOW ARE LISTED AS CARCINOGENS BY IARC, NTP OR OSHA.	CAS #	APPROX %	ACGIH-TLV	OSHA-PEL
Acetone	67-64-1	32*	750 ppm	750 ppm
Methyl Ethyl Ketone (MEK)	78-93-3	32*	200 ppm	200 ppm
Tetrahydrofuran (THF)	109-99-9	15-25	200 ppm	200 ppm
Cyclohexanone	108-94-1	15-25	25 ppm Skin	50 ppm (Trans) 25 ppm Skin

\*Title III Section 313 Supplier Notification: This product contains toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-To-Know Act of 1986 and of 40CFR372. This information must be included in all MSDS's that are copied and distributed for this material.

SHIPPING INFORMATION	SPECIAL HAZARD DESIGNATIONS		
DOT HAZARD CLASS: FLAMMABLE LIQUID DOT SHIPPING NAME: CEMENT FLAMMABLE LIQUID IDENTIFICATION NUMBER: UN/NA 1133	HMIS	NFPA	HAZARD RATING
	HEALTH: 2	2	0 - MINIMAL
	FLAMMABILITY: 3	3	1 - SLIGHT
	REACTIVITY: 0	1	2 - MODERATE
	PROTECTIVE EQUIPMENT: H	—	3 - SERIOUS
			4 - SEVERE

SECTION III - PHYSICAL DATA

APPEARANCE Clear or purple thin liquid	ODOR Ethereal	BOILING POINT (°F / °C) 133°F based on first boiling component: Acetone
SPECIFIC GRAVITY @ 73±2°F Typical 0.845 ± 0.010	VAPOR PRESSURE (mm Hg.) 190 mm Hg. based on first boiling component: Acetone @ 20°C	PERCENT. VOLATILE BY VOLUME (%) 100%
VAPOR DENSITY (Air = 1) 2.0	EVAPORATION RATE (BUAC = 1) 6-11	SOLUBILITY IN WATER Completely soluble in water

VOC STATEMENT: This cement contains 840 grams of VOC per liter as manufactured. More than 60 percent of the VOC acts as a reactive diluent and remains in the pipe joint.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT	FLAMMABLE LIMITS (PERCENT BY VOLUME)	LEL	UEL
T.C.C. 0°F-6°F Based on Acetone		2.6	13.0

FIRE EXTINGUISHING MEDIA  
Ansul "Purple K" potassium bicarbonate dry chemical, carbon dioxide, National Aer-O-Foam universal alcohol resistant foam, water spray.

SPECIAL FIRE FIGHTING PROCEDURES  
Evacuate enclosed areas, stay upwind. Close or confined quarters require self-contained breathing apparatus, positive pressure hose masks or airline masks. Use water spray to cool containers, to flush spills from source of ignition and to disperse vapors.

UNUSUAL FIRE AND EXPLOSION HAZARDS  
Fire hazard because of low flash point and high volatility. Vapors are heavier than air and may travel to source of ignition.

SECTION V - HEALTH HAZARD DATA			
PRIMARY ROUTES OF ENTRY: <input checked="" type="checkbox"/> Inhalation <input checked="" type="checkbox"/> Skin Contact <input type="checkbox"/> Eye Contact <input type="checkbox"/> Ingestion			
EFFECT OF OVEREXPOSURE <b>ACUTE:</b> Inhalation: Severe overexposure may result in nausea, dizziness, headache. Can cause drowsiness, irritation of eyes and nasal passages. Skin Contact Skin irritant Liquid contact may remove natural skin oils resulting in skin irritation. Dermatitis may occur with prolonged contact. Skin Absorption: Prolonged or widespread exposure may result in the absorption of harmful amounts of material. Eye Contact Overexposure may result in severe eye injury with corneal or conjunctival inflammation on contact with the liquid. Vapors slightly uncomfortable. Ingestion: Moderately toxic. May cause nausea, vomiting, diarrhea. May cause mental sluggishness. <b>CHRONIC:</b> None currently known.			
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE None currently known.			
EMERGENCY AND FIRST AID PROCEDURES <b>Inhalation:</b> If overcome by vapors, remove to fresh air and if breathing stopped, give artificial respiration — preferably mouth-to-mouth. If breathing is difficult, give oxygen. Call physician. <b>Eye Contact:</b> Flush eyes with plenty of water for 15 mins. and call a physician. <b>Skin Contact:</b> Remove contaminated clothing and shoes. Wash skin with plenty of soap and water for at least 15 mins. If irritation develops, get medical attention. <b>Ingestion:</b> Give 1 or 2 glasses of water or milk. Do not induce vomiting. Call physician or poison control center immediately.			
SECTION VI - REACTIVITY DATA			
STABILITY	UNSTABLE		CONDITIONS TO AVOID Keep away from heat, sparks, open flame and other sources of ignition.
	STABLE	X	
INCOMPATIBILITY (MATERIALS TO AVOID) Caustics, ammonia, inorganic acids, chlorinated compounds, strong oxidizers and isocyanates.			
HAZARDOUS DECOMPOSITION PRODUCTS When forced to burn, this product gives out carbon monoxide, carbon dioxide, toxic fumes and smoke.			
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID Keep away from heat, sparks, open flame and other sources of ignition.
	WILL NOT OCCUR	X	
SECTION VII - SPILL OR LEAK PROCEDURES			
STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED Eliminate all ignition sources. Avoid breathing of vapors. Keep liquid out of eyes. Flush with large amount of water. Contain liquid with sand or earth. Absorb with sand or nonflammable absorbent material and transfer into steel drums for recovery or disposal. Prevent liquid from entering drains.			
WASTE DISPOSAL METHOD Follow local, State and Federal regulations. Consult disposal expert. Can be disposed of by incineration. Excessive quantities should not be permitted to enter drains. Empty containers should be air dried before disposing. Hazardous Waste Code: 214			
SECTION VIII - SPECIAL PROTECTION INFORMATION			
RESPIRATORY PROTECTION (Specify type) In situations where vapor concentrations exceed the recommended exposure limits, a NIOSH-approved organic vapor cartridge respirator with full face-piece is recommended. Use only SCBA for emergencies.			
VENTILATION Explosion-proof general mechanical ventilation or local exhaust is recommended to maintain vapor concentrations below recommended exposure limits.			
PROTECTIVE GLOVES PVA coated		EYE PROTECTION Splashproof chemical goggles	
OTHER PROTECTIVE EQUIPMENT AND HYGIENIC PRACTICES Impervious apron and a source of running water to flush or wash the eyes and skin in case of contact.			
SECTION IX - SPECIAL PRECAUTIONS			
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING Store in the shade between 40°F-110°F. Keep away from heat, sparks, open flame and other sources of ignition. Avoid prolonged breathing of vapor. Use with adequate ventilation. Avoid contact with eyes, skin and clothing. Train employees on all special handling procedures before they work with this product.			
OTHER PRECAUTIONS Follow all precautionary information given on container label, product bulletins and our solvent cementing literature. All handling equipment should be electrically grounded.			



## MATERIAL SAFETY DATA SHEET

DATE PREPARED  
OR REVISED: JUNE 1990

Information on this form is furnished solely for the purpose of compliance with the Occupational Safety and Health Act and shall not be used for any other purpose. IPS Corporation urges the customers receiving this Material Safety Data Sheet to study it carefully to become aware of the hazards, if any, of the product involved. In the interest of safety, you should notify your employees, agents, and contractors of the information on this sheet.

## SECTION I

## MANUFACTURER'S NAME

IPS Corporation

## ADDRESS

17109 S. Main St., P.O. Box 379, Gardena, CA 90248

## TRANSPORTATION EMERGENCIES

CHEMTREC: (800) 424-9300

Medical Emergencies: (213) 484-5151

(L.A. Poison Center 24 Hr. No.)

Business: (213) 321-6515

## CHEMICAL NAME AND FAMILY

Solvent Cement for Plastic Pipe

Mixture of PVC Resin and Organic Solvents

## TRADE NAME

Weld-On 711 for PVC Plastic Pipe

FORMULA Proprietary

PVC  
CEMENT

## SECTION II - HAZARDOUS INGREDIENTS

NONE OF THE INGREDIENTS BELOW ARE LISTED AS CARCINOGENS  
BY IARC, NTP, OSHA.

	CAS #	APPROX %	ACGIH-TLV	OSHA-PEL
Polyvinyl Chloride Resin	9002-86-2	10-20	N/A	N/A
Tetrahydrofuran (THF)	109-99-9	55-70	200 ppm	200 ppm
Methyl Ethyl Ketone (MEK)	78-93-3	15*	200 ppm	200 ppm
Cyclohexanone	108-94-1	5-15	25 ppm Skin	50 ppm (Trans) 25 ppm Skin

\*Title III Section 313 Supplier Notification: This product contains toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-To-Know Act of 1986 and of 40CFR372. This information must be included in all MSDS's that are copied and distributed for this material.

## SHIPPING INFORMATION

DOT HAZARD CLASS: FLAMMABLE LIQUID

DOT SHIPPING NAME: CEMENT FLAMMABLE LIQUID

IDENTIFICATION NUMBER: UN/NA 1133

## SPECIAL HAZARD DESIGNATIONS

	HMIS	NFPA	HAZARD RATING
HEALTH:	2	2	0 - MINIMAL
FLAMMABILITY:	3	3	1 - SLIGHT
REACTIVITY:	0	1	2 - MODERATE
PROTECTIVE EQUIPMENT:	H	—	3 - SERIOUS 4 - SEVERE

## SECTION III - PHYSICAL DATA

APPEARANCE	ODOR	BOILING POINT (°F / °C)
White or opaque gray, medium syrupy liquid	Ethereal	151°F based on first boiling component THF
SPECIFIC GRAVITY @ 73±2°F	VAPOR PRESSURE (mm Hg.)	PERCENT VOLATILE BY VOLUME (%)
Typical 0.946 ± 0.012	143 mm Hg. based on first boiling component THF @ 20°C	Approximately 80-85%
VAPOR DENSITY (Air = 1)	EVAPORATION RATE (BUAC = 1)	SOLUBILITY IN WATER
2.49	Approx. 5-8	Solvent portion completely soluble in water. Resin portion precipitates

VOC STATEMENT: This cement contains 780 grams of VOC per liter as manufactured. More than 60 percent of the VOC acts as a reactive diluent and remains in the pipe joint.

## SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT	FLAMMABLE LIMITS (PERCENT BY VOLUME)	LEL	UEL
T.C.C. 6°F Based on THF		1.8	11.8
FIRE EXTINGUISHING MEDIA			
Ansul "Purple K" potassium bicarbonate dry chemical, carbon dioxide, National Aer-O-Foam universal alcohol resistant foam, water spray.			
SPECIAL FIRE FIGHTING PROCEDURES			
Evacuate enclosed areas, stay upwind. Close or confined quarters require self-contained breathing apparatus, positive pressure hose masks or airline masks. Use water spray to cool containers, to flush spills from source of ignition and to disperse vapors.			
UNUSUAL FIRE AND EXPLOSION HAZARDS			
Fire hazard because of low flash point and high volatility. Vapors are heavier than air and may travel to source of ignition.			

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SECTION V - HEALTH HAZARD DATA							
<b>PRIMARY ROUTES OF ENTRY</b> <input checked="" type="checkbox"/> Inhalation <input checked="" type="checkbox"/> Skin Contact <input type="checkbox"/> Eye Contact <input type="checkbox"/> Ingestion							
<b>EFFECT OF OVEREXPOSURE</b> <b>ACUTE:</b> <u>Inhalation:</u> Severe overexposure may result in nausea, dizziness, headache. Can cause drowsiness, irritation of eyes and nasal passages. <u>Skin Contact:</u> Skin irritant. Liquid contact may remove natural skin oils resulting in skin irritation. Dermatitis may occur with prolonged contact. <u>Skin Absorption:</u> Prolonged or widespread exposure may result in the absorption of harmful amounts of material. <u>Eye Contact:</u> Overexposure may result in severe eye injury with corneal or conjunctival inflammation on contact with the liquid. Vapors slightly uncomfortable. <u>Ingestion:</u> Moderately toxic. May cause nausea, vomiting, diarrhea. May cause mental sluggishness. <b>CHRONIC:</b> None currently known.							
<b>MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE</b> None currently known.							
<b>EMERGENCY AND FIRST AID PROCEDURES</b> <u>Inhalation:</u> If overcome by vapors, remove to fresh air and if breathing stopped, give artificial respiration — preferably mouth-to-mouth. If breathing is difficult, give oxygen. Call physician. <u>Eye Contact:</u> Flush eyes with plenty of water for 15 mins. and call a physician. <u>Skin Contact:</u> Remove contaminated clothing and shoes. Wash skin with plenty of soap and water for at least 15 mins. If irritation develops, get medical attention. <u>Ingestion:</u> Give 1 or 2 glasses of water or milk. Do not induce vomiting. Call physician or poison control center immediately.							
SECTION VI - REACTIVITY DATA							
<b>STABILITY</b>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">UNSTABLE</td> <td style="width: 20px;"></td> </tr> <tr> <td style="padding: 2px;">STABLE</td> <td style="text-align: center; padding: 2px;">X</td> </tr> </table>	UNSTABLE		STABLE	X	<b>CONDITIONS TO AVOID</b>	Keep away from heat, sparks, open flame and other sources of ignition.
UNSTABLE							
STABLE	X						
<b>INCOMPATIBILITY (MATERIALS TO AVOID)</b> Caustics, ammonia, inorganic acids, chlorinated compounds, strong oxidizers and isocyanates.							
<b>HAZARDOUS DECOMPOSITION PRODUCTS</b> When forced to burn, this product gives out carbon monoxide, carbon dioxide, hydrogen chloride and smoke.							
<b>HAZARDOUS POLYMERIZATION</b>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">MAY OCCUR</td> <td style="width: 20px;"></td> </tr> <tr> <td style="padding: 2px;">WILL NOT OCCUR</td> <td style="text-align: center; padding: 2px;">X</td> </tr> </table>	MAY OCCUR		WILL NOT OCCUR	X	<b>CONDITIONS TO AVOID</b>	Keep away from heat, sparks, open flame and other sources of ignition.
MAY OCCUR							
WILL NOT OCCUR	X						
SECTION VII - SPILL OR LEAK PROCEDURES							
<b>STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED</b> Eliminate all ignition sources. Avoid breathing of vapors. Keep liquid out of eyes. Flush with large amount of water. Contain liquid with sand or earth. Absorb with sand or nonflammable absorbent material and transfer into steel drums for recovery or disposal. Prevent liquid from entering drains.							
<b>WASTE DISPOSAL METHOD</b> Follow local, State and Federal regulations. Consult disposal expert. Can be disposed of by incineration. Excessive quantities should not be permitted to enter drains. Empty containers should be air dried before disposing. Hazardous Waste Code: 214							
SECTION VIII - SPECIAL PROTECTION INFORMATION							
<b>RESPIRATORY PROTECTION (Specify type)</b> In situations where vapor concentrations exceed the recommended exposure limits, a NIOSH-approved organic vapor cartridge respirator with full face-piece is recommended. Use only SCBA for emergencies.							
<b>VENTILATION</b> Explosion-proof general mechanical ventilation or local exhaust is recommended to maintain vapor concentrations below recommended exposure limits.							
<b>PROTECTIVE GLOVES</b> PVA coated		<b>EYE PROTECTION</b> Splashproof chemical goggles					
<b>OTHER PROTECTIVE EQUIPMENT AND HYGIENIC PRACTICES</b> Impervious apron and a source of running water to flush or wash the eyes and skin in case of contact.							
SECTION IX - SPECIAL PRECAUTIONS							
<b>PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING</b> Store in the shade between 40°F-110°F. Keep away from heat, sparks, open flame and other sources of ignition. Avoid prolonged breathing of vapor. Use with adequate ventilation. Avoid contact with eyes skin and clothing. Train employees on all special handling procedures before they work with this product.							
<b>OTHER PRECAUTIONS</b> Follow all precautionary information given on container label, product bulletins and our solvent cementing literature. All handling equipment should be electrically grounded.							

The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof.

Prepared by: George Blanco of IPS  
a



## MATERIAL SAFETY DATA SHEET

bun 193 p.1/2

DATE PREPARED  
OR REVISED: JUNE 1990

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Business: (213) 321-6515

## CHEMICAL NAME AND FAMILY

Solvent Cement for Plastic Pipe

Mixture of PVC Resin and Organic Solvents

## TRADE NAME

Weld-On 705 for PVC Plastic Pipe *PVC cement*

FORMULA Proprietary

## SECTION II - HAZARDOUS INGREDIENTS

NONE OF THE INGREDIENTS BELOW ARE LISTED AS CARCINOGENS BY IARC, NTP, OSHA	CAS #	APPROX %	ACGIH-TLV	OSHA-PEL
Polyvinyl Chloride Resin	9002-86-2	10-20	N/A	N/A
Tetrahydrofuran (THF)	109-99-9	30-45	200 ppm	200 ppm
Methyl Ethyl Ketone (MEK)	78-93-3	36*	200 ppm	200 ppm
Cyclohexanone	108-94-1	5-10	25 ppm Skin	50 ppm (Trans) 25 ppm Skin

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REACTIVITY:	0	1	2 - MODERATE
PROTECTIVE EQUIPMENT:	H	—	3 - SERIOUS
			4 - SEVERE

## SECTION III - PHYSICAL DATA

APPEARANCE Clear or gray syrupy liquid	ODOR Ethereal	BOILING POINT (°F / °C) 151°F based on first boiling component THF
SPECIFIC GRAVITY @ 73±2°F Typical 0.920 ± 0.020	VAPOR PRESSURE (mm Hg.) 143 mm Hg. based on first boiling component, THF @ 20°C	PERCENT. VOLATILE BY VOLUME (%) Approximately 85-90%
VAPOR DENSITY (Air = 1) 2.49	EVAPORATION RATE (BUAC = 1) Approx. 5-8	SOLUBILITY IN WATER Solvent portion completely soluble in water. Resin portion precipitates

VOC STATEMENT: This cement contains 785 grams of VOC per liter as manufactured. More than 60 percent of the VOC acts as a reactive diluent and remains in the pipe joint.

## SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT T.C.C. 6°F Based on THF	FLAMMABLE LIMITS (PERCENT BY VOLUME)	LEL 1.8	UEL 11.8
FIRE EXTINGUISHING MEDIA Ansul "Purple K" potassium bicarbonate dry chemical, carbon dioxide, National Aer-O-Foam universal alcohol resistant foam, water spray.			

## SPECIAL FIRE FIGHTING PROCEDURES

Evacuate enclosed areas, stay upwind. Close or confined quarters require self-contained breathing apparatus, positive pressure hose masks or airline masks. Use water spray to cool containers, to flush spills from source of ignition and to disperse vapors.

## UNUSUAL FIRE AND EXPLOSION HAZARDS

Fire hazard because of low flash point and high volatility. Vapors are heavier than air and may travel to source of ignition.

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SECTION V - HEALTH HAZARD DATA			
PRIMARY ROUTES OF ENTRY <input checked="" type="checkbox"/> Inhalation <input checked="" type="checkbox"/> Skin Contact <input type="checkbox"/> Eye Contact <input type="checkbox"/> Ingestion			
EFFECT OF OVEREXPOSURE <b>ACUTE:</b> <u>Inhalation:</u> Severe overexposure may result in nausea, dizziness, headache. Can cause drowsiness, irritation of eyes and nasal passages. <u>Skin Contact:</u> Skin irritant. Liquid contact may remove natural skin oils resulting in skin irritation. Dermatitis may occur with prolonged contact. <u>Skin Absorption:</u> Prolonged or widespread exposure may result in the absorption of harmful amounts of material. <u>Eye Contact:</u> Overexposure may result in severe eye injury with corneal or conjunctival inflammation on contact with the liquid. Vapors slightly uncomfortable. <u>Ingestion:</u> Moderately toxic. May cause nausea, vomiting, diarrhea. May cause mental sluggishness. <b>CHRONIC:</b> None currently known.			
MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE None currently known.			
EMERGENCY AND FIRST AID PROCEDURES <u>Inhalation:</u> If overcome by vapors, remove to fresh air and if breathing stopped, give artificial respiration — preferably mouth-to-mouth. If breathing is difficult, give oxygen. Call physician. <u>Eye Contact:</u> Flush eyes with plenty of water for 15 mins. and call a physician. <u>Skin Contact:</u> Remove contaminated clothing and shoes. Wash skin with plenty of soap and water for at least 15 mins. If irritation develops, get medical attention. <u>Ingestion:</u> Give 1 or 2 glasses of water or milk. Do not induce vomiting. Call physician or poison control center immediately.			
SECTION VI - REACTIVITY DATA			
STABILITY	UNSTABLE		CONDITIONS TO AVOID Keep away from heat, sparks, open flame and other sources of ignition.
	STABLE	X	
INCOMPATIBILITY (MATERIALS TO AVOID) Caustics, ammonia, inorganic acids, chlorinated compounds, strong oxidizers and isocyanates.			
HAZARDOUS DECOMPOSITION PRODUCTS When forced to burn, this product gives out carbon monoxide, carbon dioxide, hydrogen chloride and smoke.			
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID Keep away from heat, sparks, open flame and other sources of ignition.
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SECTION VII - SPILL OR LEAK PROCEDURES			
STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED Eliminate all ignition sources. Avoid breathing of vapors. Keep liquid out of eyes. Flush with large amount of water. Contain liquid with sand or earth. Absorb with sand or nonflammable absorbent material and transfer into steel drums for recovery or disposal. Prevent liquid from entering drains.			
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The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof.  
Prepared by George Bianco of IPS  
a

# Material Safety Data Sheet



**Paratherm Corporation**  
**NF® Heat Transfer Fluid**

Manufacturer's Name  
Address

Paratherm Corporation  
1050 Colwell Road  
Conshohocken, PA 19428

Emergency Telephone No.  
Trade Name  
Revision Date

(610) 941-4900  
Paratherm NF®  
September 15, 1995

CAS Number: 8042-47-5

TSCA Inventory Status: Included

## NFPA Hazard Identification

Degree of Hazard	Hazard Ratings
Health: 0	0—Least
Fire: 1	1—Slight
Reactivity: 0	2—Moderate
	3—High
	4—Extreme

COMPONENT NAME	CAS NUMBER	HAZARDOUS IN BLEND	PERCENTAGE Min. Max.	COMPONENT EXPOSURE LIMITS	UNITS
Hydrotreated Natural Hydrocarbon	8042-47-5	No	100.00	OSHA PEL ACGIH TLV	None established (see item III below) None established (see item III below)

## ACUTE EFFECTS

### EYE CONTACT

Paratherm NF® is non-irritating to the eyes upon direct contact.

### SKIN CONTACT

Paratherm NF® is not expected to cause any skin irritation upon direct, single or repeated and prolonged contact; however, similar chemical composition products applied to the skin of laboratory animals resulted in minimal to slight dermal irritation.

### INHALATION

Paratherm NF® has a low vapor pressure and is not expected to present an inhalation hazard at ambient conditions. Caution should be taken to prevent aerosolization or misting. The permissible exposure limit (PEL) and threshold limit value (TLV) for the fluid as oil mist is 5 mg/m<sup>3</sup>. Exposures below 5 mg/m<sup>3</sup> appear to be without significant health risk.

### INGESTION

Ingestion is relatively non-toxic unless aspiration occurs. Paratherm NF has laxative properties and may result in abdominal cramps and diarrhea. See Health Data Section below.

## CHRONIC EFFECTS

On rare occasions, prolonged and repeated exposure to oil mist poses a risk of pulmonary disease such as chronic lung inflammation. This condition is usually asymptomatic as a result of repeated small aspirations. Shortness of breath and cough are the most common symptoms. Aspiration may lead to chemical pneumonitis which is characterized by pulmonary edema and hemorrhage, and may be fatal. Signs of lung involvement include increased respiration rate, increased heart rate, and a bluish discoloration of the skin. Coughing, choking, and gagging are often noted at the time of aspiration. Gastrointestinal discomfort may develop, followed by vomiting, with a further risk of aspiration.

### CARCINOGENICITY

NTP: No

IARC: N-

OSHA: No

## SAFETY AND PROCEDURES

### EYE CONTACT

Immediately flush eyes with large amounts of water and continue flushing for 15 minutes. If fluid is hot, treat for thermal burns and take victim to hospital immediately.

### SKIN CONTACT

Remove contaminated clothing. If fluid is hot, submerge injured area in cold water. If victim is severely burned, take to a hospital immediately.

### INHALATION

Paratherm NF® has a low vapor pressure and is not expected to present

an inhalation hazard at ambient conditions. If vapor or mist is generated when the fluid is heated or handled, remove victim from exposure. If breathing has stopped or is irregular, administer artificial respiration and supply oxygen if it is available. If victim is unconscious, remove to fresh air and seek medical attention.

### INGESTION

May act as a laxative. Do not induce vomiting due to possible aspiration. If vomiting occurs, lower head below knees to avoid aspiration. Seek immediate medical attention.

## PERSONAL HEALTH PROTECTION INFORMATION

### EYE PROTECTION

Eye protection is not required under conditions of normal use. If the fluid is handled such that it could be splashed into eyes, wear plastic face shield or splash-proof safety goggles.

### SKIN PROTECTION

No skin protection is required for single, short duration exposures. For prolonged or repeated exposures, use impervious synthetic rubber clothing (boots, gloves, aprons, etc.) over parts of the body subject to exposure. If handling hot fluid, use insulated protective clothing (boots, gloves, aprons, etc.).

### RESPIRATORY PROTECTION

Respiratory protection is not required under conditions of normal use. If vapor or mist is generated when the fluid is heated or handled, use an

organic vapor respirator with a dust and mist filter. All respirators must be NIOSH certified. Do not use compressed oxygen in hydrocarbon atmospheres.

### VENTILATION

If vapor or mist is generated when the fluid is heated or handled, adequate ventilation in accordance with good engineering practice must be provided to maintain concentrations below the specified exposure or flammable limits.

### OTHER

Consumption of food and beverages should be avoided in work areas where hydrocarbons are present. Always wash hands and face with soap and water before eating, drinking or smoking.

FLASH POINT  
FLASH POINT  
FIRE POINT  
AUTOIGNITION TEMPERATURE  
AUTOIGNITION TEMPERATURE

345°F (174°C)  
335°F (169°C)  
335°F (166°C)  
690°F (366°C)  
691°F (367°C)

TEST METHOD  
TEST METHOD  
TEST METHOD  
TEST METHOD  
TEST METHOD

ASTM D-92 (COC)  
ASTM D-93 (PMCC)  
ASTM D-92 (COC)  
ASTM D-2155  
ASTM E-659-78

FLAMMABLE LIMITS IN AIR % BY VOL

LOWER No data

UPPER No data

#### EXTINGUISHING MEDIA

Use dry chemical, foam, water fog, or carbon dioxide

as nothing may occur, especially if sprayed into containers of hot, burning liquid.

#### SPECIAL FIRE FIGHTING PROCEDURES

Water may be ineffective but can be used to cool containers exposed to heat or flame. Caution should be exercised when using water or foam

#### UNUSUAL FIRE AND EXPLOSIVE CONDITIONS

Dense smoke may be generated while burning. Carbon monoxide, carbon dioxide, and other oxides may be generated as products of combustion.

STABILITY (THERMAL, LIGHT, ETC.)

Stable

HAZARDOUS POLYMERIZATION

Will not occur

CONDITIONS TO AVOID

None

INCOMPATIBILITY (MATERIALS TO AVOID)

May react with strong oxidizing agents

HAZARDOUS DECOMPOSITION PRODUCTS

If burned, will produce carbon dioxide and carbon monoxide

## VII. ENVIRONMENTAL PRECAUTIONS

#### STEPS TO BE TAKEN IF FLUID IS RELEASED OR SPILLED

Consult health effect information in Section III, Personal Health Protection Information in Section V, Fire Protection Information in Section VI, and Reactivity Data in Section VII. Notify appropriate authorities of spill. Contain spill immediately. Do not allow spill to enter sewers or watercourses; remove all sources of ignition. Absorb with appropriate inert materials such as sand, clay, etc. Large spills may be picked up using vacuum pumps, shovels, buckets or other means and placed in drums or other suitable containers.

#### WASTE DISPOSAL METHOD

All disposals must comply with federal, state and local regulations. The fluid, if spilled or discarded, may be a regulated waste. Refer to state and local regulations. Caution: If regulated solvents are used to clean up spilled fluid, the resulting waste mixture may be regulated. Department of Transportation (DOT) regulations may apply for transporting this material when spilled. Waste material may be landfilled or incinerated at an approved facility. Materials should be recycled if possible. This material, as supplied, is not regulated by RCRA as hazardous waste.

## VIII. HANDLING

#### HANDLING AND STORAGE REQUIREMENTS

Do not transfer to unmarked containers. Store in closed containers away from heat, sparks, open flame, or oxidizing materials. Paratherm NF® is not classified as hazardous under DOT regulations. Fire extinguishers should be kept readily available. See NFPA 30 and OSHA 1910.106—Flammable and combustible liquids.

#### ADDITIONAL INFORMATION

SARA Title III. Paratherm NF® is not subject to the reporting requirements of section 313 of Title III of the Superfund Amendment & Reauthorization Act of 1986, and 40 C.F.R. part 372.

BOILING POINT  
MELTING POINT  
APPEARANCE  
ODOR  
VAPOR PRESSURE  
SOLUBILITY

646°F, 347°C (10% fraction)  
Not applicable  
Clear liquid  
Odorless  
<1 mm Hg @ 70°F  
Negligible in water. Soluble in hydrocarbons.

PERCENT VOLATILE  
VAPOR DENSITY (AIR=1)  
EVAPORATION RATE (EE-1)  
TYPICAL SPECIFIC GRAVITY  
MOLECULAR WEIGHT

N/A @ Ambient Temperature  
>1  
<1  
Approx. 0.8734 @ 25/25 C  
Average Molecular Weight = 350

## IX. REGULATORY INFORMATION

Not regulated by D.O.T., no placarding required.

NOTE: We present the information and recommendations in this bulletin in good faith and believe them to be correct, however, Paratherm Corporation makes no representations as to accuracy or completeness. We supply this information on the condition that the user determine suitability of product

for each specific application. We warrant that the heat transfer fluid conforms to the specifications in this bulletin, but make no further warranty expressed or implied, including the warranties of merchantability or fitness for a particular purpose.





**MATERIAL SAFETY DATA SHEET****3190K245,246****1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION****NO: 3300****MSDS NUMBER :** M25052**ISSUE DATE :** 10-05-95**PRODUCT NAME :** ETHYLENE GLYCOL - INDUSTRIAL GRADE

**Manufacturer's Name and Address :** Occidental Chemical Corporation, Occidental Tower  
5005 LBJ Freeway, P.O. Box 809050  
Dallas, TX 75380 (214) 404-3800

**24 HOUR EMERGENCY TELEPHONE :** 1-800-733-3665 OR 716-278-7021**TO REQUEST AN MSDS :** 1-800-699-4970**CUSTOMER SERVICE :** 1-800-752-5151**PRODUCT USE :** Coolant Fluids**CHEMICAL NAME :** Ethylene Glycol**CHEMICAL FORMULA :** C<sub>2</sub>H<sub>6</sub>O<sub>2</sub>

**SYNONYMS/COMMON NAMES :** EG  
Monoethylene Glycol  
MEG

**2. COMPOSITION/INFORMATION ON INGREDIENTS**

**CAS NUMBER / NAME**  
107-21-1 1,2-Ethanediol

**EXPOSURE LIMITS**

PEL: 50 ppm; 125 mg/m<sup>3</sup>, Ceiling  
TLV: 50 ppm; 127 mg/m<sup>3</sup>, Ceiling

**PERCENTAGE**

VOL	ND
WT	95-100

**COMMON NAMES:**  
ETHYLENE GLYCOL#

**Listed On (List Legend Below) :**  
00 02 13 16 18 22

## 2. COMPOSITION/INFORMATION ON INGREDIENTS (Continued)

10:3300

111-46-6 Ethanol, 2,2'-oxybis-

### EXPOSURE LIMITS

PEL:Not Established  
TLV:Not Established

### PERCENTAGE

VOL ND  
WT 0-5

### COMMON NAMES:

DIETHYLENE GLYCOL

Listed On(List Legend Below):

00 12 22 23

# Chemical name used in the SARA Section 313 List of Toxic Chemicals (40 CFR - Section 372.65) if different from CAS name.

### LIST LEGEND

00 TSCA INVENTORY	02 SARA TOXIC CHEM, SECTION 313
12 PA HAZARDOUS SUBSTANCE	13 PA ENVIROMENTAL HAZ SUBSTANCE
16 NJ WORKPLACE HAZ SUBSTANCE LST	18 NY HAZARDOUS SUBSTANCES
22 CANADIAN DOMESTIC SUB LIST	23 NJ REQUIREMENT- 1% OR GREATER

## 3. HAZARDS IDENTIFICATION

\*\*\*\*\* EMERGENCY OVERVIEW \*\*\*\*\*

- MAY CAUSE IRRITATION BY ALL ROUTES OF EXPOSURE. INHALATION OR
- INGESTION MAY CAUSE SYMPTOMS OF CENTRAL NERVOUS DEPRESSION,
- KIDNEY AND LIVER DAMAGE. POSSIBLE BIRTH DEFECT HAZARD. MAY CAUSE
- BIRTH DEFECTS BASED ON ANIMAL DATA.

Clear colorless, slightly viscous liquid; mild odor

### POTENTIAL HEALTH EFFECTS

#### ROUTES OF ENTRY:

Inhalation, Skin, Ingestion.

#### TARGET ORGANS:

Central Nervous System, Liver, Kidneys.

#### IRRITANCY:

Eyes, Respiratory Tract.

#### SENSITIZING CAPABILITY:

None known.

#### REPRODUCTIVE EFFECTS:

May cause adverse reproductive effects and birth defects based on laboratory animal data.

### 3. HAZARDS IDENTIFICATION (Continued)

No. 3300

#### CANCER INFORMATION:

Not known to be carcinogenic.

#### SHORT-TERM EXPOSURE (ACUTE)

##### INHALATION:

May produce symptoms of central nervous system depression including headache, dizziness, nausea, loss of sense of balance, drowsiness, visual disturbances, unconsciousness and death.

Due to low vapor pressure, inhalation of vapor is unlikely except at elevated temperatures; small aerosol droplets may be inhaled.

Other signs may include fluid in the lungs, irregular eye movements.

##### EYES:

May be irritating.

##### SKIN:

In severe overexposure enough material might be absorbed to cause systemic injury.

##### INGESTION:

Central Nervous System symptoms similar to those by inhalation; followed by rapid breathing, increased heart rate, possible decreased urine volume and severe metabolic acidosis.

#### REPEATED EXPOSURE (CHRONIC)

Prolonged or repeated inhalation or ingestion may result in kidney and liver changes.

Repeated exposure may cause liver and kidney damage.

#### SYNERGISTIC MATERIALS:

None known.

#### MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:

Pre-existing liver or kidney disorders.

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### 4. FIRST AID MEASURES

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#### EYES:

IMMEDIATELY FLUSH EYES WITH A DIRECTED STREAM OF WATER for at least 15 minutes, forcibly holding eyelids apart to ensure complete irrigation of all eye and lid tissue. Washing eyes within several seconds is essential to achieve maximum effectiveness. GET MEDICAL ATTENTION IMMEDIATELY.

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#### 4. FIRST AID MEASURES (Continued)

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NO:3300

##### SKIN:

Wash thoroughly with soap and water. Wash clothing before reuse. IF IRRITATION OCCURS, GET MEDICAL ATTENTION.

##### INHALATION:

Remove to fresh air. If breathing is difficult, have trained person administer oxygen. If respiration stops, give mouth-to-mouth resuscitation. GET MEDICAL ATTENTION IMMEDIATELY.

##### INGESTION:

NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. Have patient drink several glasses of water then induce vomiting by having patient tickle back of throat with finger. Keep airway clear. GET MEDICAL ATTENTION IMMEDIATELY.

##### NOTES TO PHYSICIAN:

Can cause pulmonary edema. Ethylene glycol when swallowed is toxic to the kidneys and caused metabolic acidosis.

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#### 5. FIRE FIGHTING MEASURES

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Flash Point: 241°F, 116°C

Method: Closed cup

Autoignition Temperature: Not Determined

##### FLAMMABLE LIMITS IN AIR BY % VOLUME

Upper: 15.3%

Lower: 3.2%

##### EXTINGUISHING MEDIA:

Alcohol foam, dry chemical, Halon, carbon dioxide, water fog or spray.

##### FIRE FIGHTING PROCEDURES:

Use water spray to keep fire-exposed containers cool.

##### FIRE AND EXPLOSION HAZARD:

Combustible liquid.

##### SENSITIVITY TO MECHANICAL IMPACT:

Not applicable.

##### SENSITIVITY TO STATIC DISCHARGE:

Not applicable.

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## 6. ACCIDENTAL RELEASE MEASURES

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NO: 3300

### PERSONAL PRECAUTIONS:

Follow protective measures provided under Personal Protection in Section 8.

### ENVIRONMENTAL PRECAUTIONS:

Contain spill with dike to prevent entry into sewers or waterways.

NEVER FLUSH TO SEWER.

### METHODS FOR CLEANING UP:

Recover liquid for reuse or reclamation. Recover spilled material with absorbent and place in approved containers for disposal. DO NOT FLUSH TO SEWERS.

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## 7. HANDLING AND STORAGE

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### HANDLING:

Avoid open agitation or heating which may generate vapors or mists.

### SPECIAL MIXING AND HANDLING INSTRUCTIONS:

Not applicable.

### STORAGE:

Store containers in a cool, dry, ventilated, fire resistant area away from sources of ignition and incompatible materials.

Keep container tightly closed and properly labeled.

---

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

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### ENGINEERING CONTROLS:

General room ventilation plus local exhaust at points of emission to maintain levels of airborne contaminants below exposure limits.

### PERSONAL PROTECTION

#### RESPIRATORY:

Wear a NIOSH/MSHA approved respirator following manufacturer's recommendations, where airborne contaminants may occur.

For emergencies and unknown concentrations, use NIOSH/MSHA approved positive pressure self-contained breathing apparatus. Utilize respiratory protective equipment in accordance with 29CFR 1910.134 (Respiratory Protection).

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION (Continued)

No. 3300

### EYE/FACE:

Wear chemical safety goggles plus full face shield to protect against splashing when appropriate (ANSI 287.1).

### SKIN:

Wear chemical resistant gloves such as rubber, neoprene or vinyl.

### OTHER:

Emergency shower and eyewash facility should be in close proximity (ANSI Z358.1).

## 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance and Odor: Clear colorless, slightly viscous liquid;  
mild odor

Odor Threshold: Not available

Specific Gravity (Water=1): 1.115 @ 20°C/20°C

Vapor Pressure: 0.06mm Hg @ 20°C

Vapor Density (Air=1): 2.1

Density: Not available

Evaporation Rate: Not available

% Volatiles by Wt: Essentially zero

Boiling Point: 198°C (388°F)

Freezing Point: -13°C (8.6°F)

Melting Point: -13°C (8.6°F)

Solubility in Water (% by wt.): Complete

pH: 6-8 (near neutral)

Octanol/Water Partition Coefficient: Not available

Thermal Decomposition Temperature: Not available

Other: Not available

VOC (% by wt.): Not applicable

## 10. STABILITY AND REACTIVITY

M:3300

### CHEMICAL STABILITY:

X STABLE        UNSTABLE

### REACTS WITH:

<u>      </u> AIR	<u>X</u> OXIDIZERS	<u>      </u> METALS
<u>      </u> WATER	<u>X</u> ACIDS	<u>      </u> OTHER
<u>      </u> HEAT	<u>X</u> ALKALIS	<u>      </u> NONE

### HAZARDOUS POLYMERIZATION:

       OCCURS X WILL NOT OCCUR

### COMMENTS:

Avoid contact with oxidizing agents.

### HAZARDOUS DECOMPOSITION PRODUCTS:

Carbon monoxide and carbon dioxide.

## 11. TOXICOLOGICAL INFORMATION

### 107-21-1 Ethylene glycol

ACUTE ORAL LD50 :	(rat)	4700 mg/kg
ACUTE DERMAL LD50 :	(rabbit)	19.5 g/kg
PRIMARY SKIN IRRITATION :	(rabbit)	mild
PRIMARY EYE IRRITATION :	(rabbit, 1hr)	mild

Ethylene glycol produces birth defects when orally administered to pregnant mice and rats at doses of 500 and 1000 mg/kg/day, respectively, during gestation. The no-effect levels for these effects were 150 and 500 mg/kg/day, respectively, in the mouse and rat. Minimal evidence for birth defects were detected in the offspring of mice exposed to aerosol concentrations up to 2500 mg/m<sup>3</sup>, 6 hrs/day during gestation. Dermal exposure of pregnant mice to 3549 mg/kg/day during gestation produced no maternal toxicity and minimal if any birth defects. There is no current information to suggest that ethylene glycol produces birth defects in humans.

### 111-46-6 Diethylene glycol

ACUTE ORAL LD50 :	(rat)	12500 mg/kg
	(human)	1000 mg/kg
ACUTE DERMAL LD50 :	(rabbit)	12000 mg/kg
ACUTE INHALATION LCLO :	(mouse, 2hr)	130 mg/m <sup>3</sup>
PRIMARY SKIN IRRITATION :	(rabbit)	mild
PRIMARY EYE IRRITATION :	(rabbit)	mild

## 11. TOXICOLOGICAL INFORMATION (Continued)

NO: 3300

In vitro, no evidence of mutagenicity. No in vivo evidence of carcinogenicity or adverse reproductive effects in animal studies.

## 12. ECOLOGICAL INFORMATION

No Ecological Data Available.

## 13. DISPOSAL CONSIDERATIONS

Dispose of all waste and contaminated equipment in accordance with all applicable federal, state and local health and environmental regulations.

## 14. TRANSPORT INFORMATION

DOT INFORMATION: Not Regulated

## 15. REGULATORY INFORMATION

### U.S. FEDERAL REGULATIONS:

This product contains a toxic chemical or chemicals subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR 372. See Section 2, List Legend 02.

OSHA Standard 29 CFR 1910.1200 requires that information be provided to employees regarding the hazards of chemicals by means of a hazard communication program including labeling, material safety data sheets, training and access to written records. We request that you, and it is your legal duty to, make all information in this Material Safety Data Sheet available to your employees.

To aid our customers in complying with regulatory requirements, SARA Title III Hazard Categories for this product are indicated below. If the word "YES" appears next to any category, this product may be reportable by you under the requirements of 40.CFR.370. Please consult those regulations for details.

### TSCA:

All components of this product that are required to be on the TSCA inventory are listed on the inventory.



15. REGULATORY INFORMATION (Continued)

NO: 3300

SARA/TITLE III HAZARD CATEGORIES:

Immediate (Acute) Health:	<u>NO</u>	Reactive Hazard	<u>NO</u>
Delayed (Chronic) Health:	<u>YES</u>	Sudden Release of Pressure	<u>NO</u>
Fire Hazard:	<u>NO</u>		

HMIS HAZARD RATINGS:

HEALTH HAZARD: 1\* FIRE HAZARD: 1 REACTIVITY: 0

STATE REGULATIONS:

See Section 2. COMPOSITION/INFORMATION ON INGREDIENTS list legend for applicable state regulation.

Consult local laws for applicability.

INTERNATIONAL REGULATIONS:

Consult the regulations of the importing country.

CANADA:

WHMIS Hazard Class: A, B1, D1A, D2A, F

16. OTHER INFORMATION

For additional non-emergency health, safety or environmental information telephone (716) 286-3042 or write to:

Occidental Chemical Corporation  
Product Stewardship Department  
360 Rainbow Boulevard South  
P.O. Box 728  
Niagara Falls, New York 14302-0728

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16. OTHER INFORMATION (Continued)

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NO. 3300

MSDS LEGEND:

ACGIH - American Conference of Governmental Industrial Hygienists

CAS - Chemical Abstracts Service Registry Number

CEILING - Ceiling Limit (15 Minutes)

CEL - Corporate Exposure Limit

OSHA - Occupational Safety and Health Administration

PEL - Permissible Exposure Limit (OSHA)

STEL - Short Term Exposure Limit (15 Minutes)

TDG - Transportation of Dangerous Goods (Canada)

TLV - Threshold Limit Value (ACGIH)

TWA - Time Weighted Average (8 Hours)

WHMIS - Worker Hazardous Materials Information System (Canada)

IMPORTANT: The information presented herein, while not guaranteed, was prepared by competent technical personnel and is true and accurate to the best of our knowledge. NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE, OR OF ANY OTHER KIND, EXPRESS OR IMPLIED, IS MADE REGARDING PERFORMANCE, STABILITY OR OTHERWISE. This information is not intended to be all-inclusive as to the manner and conditions of use, handling and storage. Other factors may involve other or additional safety or performance considerations. While our technical personnel will be happy to respond to questions regarding safe handling and use procedures, safe handling and use remains the responsibility of the customer. No suggestions for use are intended as, and nothing herein shall be construed as a recommendation to infringe any existing patents or violate any federal, state or local laws, rules, regulations or ordinances.

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17. WARNING LABEL INFORMATION

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SIGNAL WORD:

CAUTION

HAZARD WARNINGS:

MAY CAUSE IRRITATION BY ALL ROUTES OF EXPOSURE.

INHALATION OR INGESTION MAY CAUSE SYMPTOMS OF CENTRAL NERVOUS DEPRESSION, KIDNEY AND LIVER DAMAGE.

POSSIBLE BIRTH DEFECT HAZARD. MAY CAUSE BIRTH DEFECTS BASED ON ANIMAL DATA.

PRECAUTIONS:

Avoid contact with eyes, skin and clothing.

17. WARNING LABEL INFORMATION (Continued)

No. 3300

Avoid breathing vapors.

Wash thoroughly after handling.

Keep container tightly closed and properly labeled.

Keep away from heat, sparks, pilot lights, welding operations and open flame.

Avoid contact with oxidizers, strong acids and alkalis.

Do not reuse container. Product residues may remain. All labeled precautions MUST be observed.

FIRST AID

EYES:

IMMEDIATELY FLUSH EYES WITH A DIRECTED STREAM OF WATER for at least 15 minutes, forcibly holding eyelids apart to ensure complete irrigation of all eye and lid tissue. Washing eyes within several seconds is essential to achieve maximum effectiveness. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN:

Wash thoroughly with soap and water. Wash clothing before reuse. IF IRRITATION OCCURS, GET MEDICAL ATTENTION.

INHALATION:

Remove to fresh air. If breathing is difficult, have trained person administer oxygen. If respiration stops, give mouth-to-mouth resuscitation. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:

NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. Have patient drink several glasses of water then induce vomiting by having patient tickle back of throat with finger. Keep airway clear. GET MEDICAL ATTENTION IMMEDIATELY.

IN CASE OF SPILL OR LEAK:

Wear full protective equipment and clothing.

Contain liquids and prevent discharges to streams or sewers system

Do not flush to sewer.

Small spills may be soaked up with compatible absorbent material and then placed in closed containers to await proper disposal.

FIRE:

Use water fog, alcohol foam, dry chemical, carbon dioxide.

Evacuate unprotected personnel in downwind areas.

Use NIOSH/MSHA self-contained breathing apparatus and full protective equipment.

17. WARNING LABEL INFORMATION (Continued)

No. 3300

**HANDLING AND STORAGE:**

Store in a cool, dry, well ventilated area away from incompatible materials.

Keep away from heat, sparks and open flames.

Store in closed and properly labeled containers.

Containers that have been emptied, will retain product residue and vapor and should be handled as if they were full.

**DISPOSAL:**

This product when spilled or disposed of is a non-hazardous solid waste (40 CFR 261).

Dispose of in accordance with federal, state and local regulations.

**This Product Contains:**

CAS#	NAME
107-21-1	1,2-Ethanediol
111-46-6	Ethanol, 2,2'-oxybis-

HMIS RATING: HEALTH 1\* FLAMMABILITY 1 REACTIVITY 0

LABEL NUMBER: 122M25052

For Industrial Use Only



# MATERIAL SAFETY DATA SHEET

## Rohm and Haas Company

### 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

AMBERSORB® 600 Carbonaceous Adsorbent

Product Code : 76339  
Key : 864550-3

MSDS Date : 03/13/96

COMPANY IDENTIFICATION  
Rohm and Haas Company  
100 Independence Mall West  
Philadelphia, PA 19106-2399

EMERGENCY TELEPHONE NUMBERS  
HEALTH EMERGENCY : 215-592-3000  
SPILL EMERGENCY : 215-592-3000  
CHEMTREC : 800-424-9300

AMBERSORB® is a trademark of Rohm and Haas Company or one of its subsidiaries or affiliates.

### 2. COMPOSITION/INFORMATION ON INGREDIENTS

No.		CAS REG NO.	WEIGHT(%)
1	Carbonaceous absorbent	Not Hazardous	> 95
2	Water	7732-18-5	< 5

See SECTION 8. Exposure Controls / Personal Protection

### 3. HAZARDS IDENTIFICATION

#### Primary Routes of Exposure

Skin Contact  
Eye Contact

#### Eye Contact

Material can cause the following:  
- slight irritation

#### Skin Contact

Prolonged or repeated skin contact can cause the following:  
- slight skin irritation

### 4. FIRST AID MEASURES

#### Eye Contact

Flush eyes with a large amount of water for at least 15 minutes. Consult a physician if irritation persists.

CONTINUATION  
Skin Contact

Wash affected skin areas thoroughly with soap and water.

5. FIRE FIGHTING MEASURES

Flash Point	Not Applicable
Auto-ignition Temperature	800°C/1472°F Estimate
Lower Explosive Limit	Not Applicable
Upper Explosive Limit	Not Applicable

Extinguishing Agents

Use the following extinguishing media when fighting fires involving this material:  
- dry chemical - foam - water spray

Personal Protective Equipment

Wear self-contained breathing apparatus (pressure-demand MSHA NIOSH approved or equivalent) and full protective gear

6. ACCIDENTAL RELEASE MEASURES

Personal Protection

Wear gloves made of the following material:  
- cotton or canvas  
Additional personal protective equipment should include the following:  
- safety glasses (ANSI Z87.1 or approved equivalent)

Procedures

Floor may be slippery; use care to avoid falling. Transfer spilled material to suitable containers for recovery or disposal.

7. HANDLING AND STORAGE

Storage Conditions

The maximum recommended storage temperature for this material is 204C/400F.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION



Rohm and Haas Company  
100 Independence Mall West  
Philadelphia PA 19106-2399

PRODUCT AMBERSORB® 600 Carbonaceous  
Adsorbent  
KEY: 864550-3  
DATE: 03/13/96

## CONTINUATION

### Exposure Limit Information

No.		CAS REG NO.	WEIGHT(%)
1	Carbonaceous adsorbent	Not Hazardous	> 95
2	Water	7732-18-5	< 5

Component		ROHM AND HAAS		OSHA		ACGIH	
No.	Units	TWA	STEL	TWA	STEL	TWA	STEL
1		None	None	None	None	None	None
2		None	None	None	None	None	None

### Respiratory Protection

A respiratory protection program meeting OSHA 1910.134 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrant a respirator's use. None required under normal operating conditions.

### Eye Protection

Use safety glasses (ANSI Z87.1 or approved equivalent)

### Engineering Controls (Ventilation)

The ventilation system employed is dependent on the user's specific application of this material. Refer to the current edition of Industrial Ventilation: A Manual of Recommended Practice published by the American Conference of Governmental Industrial Hygienists for information on the design, installation, use, and maintenance of exhaust systems

### Other Protective Equipment

Facilities storing or utilizing this material should be equipped with an eyewash facility.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

Color	Black
State	Beads
Odor Characteristic	Odorless
Viscosity	Not Applicable
Specific Gravity (Water = 1)	> 1
Vapor Density (Air = 1)	Not Applicable
Melting Point	3680 °C 6656 °F Estimate
Boiling Point	4200 °C 7592 °F Estimate
Solubility in Water	Practically insoluble
Percent Volatility	< 5% Water
Evaporation Rate (BAc = 1)	Not Applicable

See SECTION 5. Fire Fighting Measures

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## 10. STABILITY AND REACTIVITY

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### Instability

This material is considered stable under specified conditions of storage, shipment and/or use. See SECTION 7, Handling And Storage, for specified conditions.

### Hazardous Decomposition Products

Thermal decomposition may yield the following:  
- sulfur oxides - hydrogen sulfide

### Hazardous Polymerization

Product will not undergo polymerization.

### Incompatibility

Avoid contact with strong oxidizing agents, particularly concentrated nitric acid.

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## 11. TOXICOLOGICAL INFORMATION

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### Acute Data

No toxicity data are available for this material.

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## 12. ECOLOGICAL INFORMATION

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No Applicable Data

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## 13. DISPOSAL CONSIDERATIONS

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### Procedure

Unused resin may be incinerated or landfilled in facilities meeting local, state, and federal regulations. For contaminated resin, the user must determine the hazard and use an appropriate disposal method.

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## 14. TRANSPORT INFORMATION

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US DOT Hazard Class

NONREGULATED

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## 15. REGULATORY INFORMATION

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### Workplace Classification

This product is considered non-hazardous under the OSHA Hazard Communication Standard (29CFR 1910.1200).





Rohm and Haas Company  
100 Independence Mall West  
Philadelphia PA 19106-2399

PRODUCT AMBERSORB® 600 Carbonaceous  
Adsorbent  
KEY: 864550-3  
DATE: 03/13/96

#### CONTINUATION

This product is not a 'controlled product' under the Canadian Workplace Hazardous Materials Information System (WHMIS).

#### SARA TITLE 3: Section 311/312 Categorizations (40CFR 370)

This product is not a hazardous chemical under 29CFR 1910.1200, and therefore is not covered by Title III of SARA.

#### SARA TITLE 3: Section 313 Information (40CFR 372)

This product does not contain a chemical which is listed in Section 313 at or above de minimis concentrations.

#### CERCLA Information(40CFR 302.4)

This material contains no hazardous or extremely hazardous substances as defined by CERCLA or SARA Title III and releases are therefore not reportable.

#### Waste Classification

When a decision is made to discard this material as supplied, it does not meet RCRA's characteristic definition of ignitability, corrosivity, or reactivity, and is not listed in 40 CFR 261.33. The toxicity characteristic (TC), however, has not been evaluated by the Toxicity Characteristic Leaching Procedure (TCLP).

#### United States

All components of this product are in compliance with the inventory listing requirements of the U.S. Toxic Substances Control Act (TSCA) Chemical Substance Inventory.

#### Pennsylvania

Any material listed as 'Not Hazardous' in the CAS REG NO. column of SECTION 2, Composition/Information On Ingredients, of this MSDS is a trade secret under the provisions of the Pennsylvania Worker and Community Right-to-Know Act

#### 16. OTHER INFORMATION

Rohm and Haas Hazard Rating		Scale
Toxicity	1	4 = EXTREME 3 = HIGH 2 = MODERATE 1 = LOW
Fire	1	3 = EXTREME 2 = MODERATE 1 = LOW
Reactivity	0	4 = EXTREME 3 = HIGH 2 = MODERATE 1 = LOW
Special	-	

Ratings are based on Rohm and Haas guidelines, and are intended for internal use.

ABBREVIATIONS:

ACGIH = American Conference of Governmental Industrial Hygienists  
OSHA = Occupational Safety and Health Administration  
TLV = Threshold Limit Value  
PEL = Permissible Exposure Limit  
TWA = Time Weighted Average  
STEL = Short-Term Exposure Limit  
BAc = Butyl acetate  
Bar denotes a revision from previous MSDS in this area.

The information contained herein relates only to the specific material identified. Rohm and Haas Company believes that such information is accurate and complete at the date of this material safety data sheet, but no representation, guarantee or warranty, express or implied, is made as to the accuracy, reliability or completeness of the information. Rohm and Haas Company urges persons using this information to make their own determination as to the information's suitability and completeness for their particular application.

3710960313

# MATERIAL SAFETY DATA SHEET



## LIQUID CARBONIC SPECIALTY GAS CORPORATION

175 SOUTH LA SALLE STREET • CHICAGO, ILLINOIS 60607-4232  
PHONE: (312) 855-2500

Isobutylene

Revision Feb. 1987

24 Hour Emergency Phone Numbers: (504)673-8831; CHEMTREC (800)424-9300

### SECTION I--PRODUCT IDENTIFICATION

CHEMICAL NAME: Isobutylene

COMMON NAME AND SYNONYMS: Isobutene, 2-Methylpropene

CHEMICAL FAMILY: Aliphatic Hydrocarbons

FORMULA:  $(CH_2)_2CH$

### SECTION II--HAZARDOUS INGREDIENTS

MATERIAL	VOLUME %	CAS NO.	1985-6 ACGIH TLV UNITS
Isobutylene	99.5	115-11-7	TWA 1,000 ppm STEL 1,250 ppm for LPG (Liquified Petroleum Gas)

### SECTION III--PHYSICAL DATA

BOILING POINT (°F.)	19.6	SPECIFIC GRAVITY ( $H_2O=1$ )	0.594 @ 20°C
VAPOR PRESSURE (mmHg.)	24.3 psig @ 70°F	% VOLATILE BY VOLUME	100
VAPOR DENSITY (AIR=1)	2.011	EVAPORATION RATE (BUTYL ACETATE=1)	Rapid
SOLUBILITY IN WATER	Insoluble		
APPEARANCE AND ODOR	A colorless flammable gas with an unpleasant odor similar to coal gas.		

### SECTION IV--FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED) -105°F (C.C.) FLAMMABLE LIMITS LEL 1.8 UEL 8.8

EXTINGUISHING MEDIA: Carbon Dioxide, dry chemical, halon and water.

SPECIAL FIRE FIGHTING PROCEDURES: Stop flow of gas if possible. Use water spray to cool fire exposed containers. If feasible, allow fire to burn itself out to avoid accumulation of an unburned flammable mixture.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Keep personnel away from fire scene since containers can rupture violently when exposed to fire. Fire fighters should use self-contained breathing apparatus and protective clothing. Unless gas supply is shut-off, it can reignite or explode. Vapor can flow to distant ignition source than flash back.

### SECTION V--HEALTH HAZARD DATA

Route(s) of Entry: Inhalation? Yes Skin? Yes Ingestion? No

Carcinogenicity: NTP? No IARC Monographs? No OSHA? No

EFFECTS OF OVEREXPOSURE: Isobutylene is defined as a simple asphyxiant by displacing air. Can cause dizziness, drowsiness, and eventual unconsciousness. Liquid contact with eyes or skin may cause tissue freezing or frostbite.

EMERGENCY AND FIRST AID PROCEDURES: If inhaled: Remove to fresh air. Obtain prompt medical assistance. Unconscious persons should be given artificial resuscitation and supplemental oxygen. Keep warm and at rest.

Eye or skin contact: Promptly flush affected areas with copious quantities of tepid water (105-115°F). Remove contaminated clothing. A physician should see the patient promptly, if cryogenic burn has resulted in blistering of the dermal surface or deep tissue freezing.

SECTION VI--REACTIVITY DATA

STABILITY: UNSTABLE ( ) STABLE (X)

CONDITIONS TO AVOID: Heat, flame, direct sunlight and ignition sources.

INCOMPATABILITY (MATERIALS TO AVOID): Oxygen and strong oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS: CO<sub>2</sub> and water vapor. Can produce carbon monoxide when oxidized with deficiency of oxygen.

HAZARDOUS POLYMERIZATION: MAY OCCUR ( ) WON'T OCCUR (X)

CONDITIONS TO AVOID: N/A

SECTION VII--SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Evacuate all personnel from affected area. Stop leaks if possible. Emergency personnel should use self-contained breathing apparatus and should have protective clothing. Eliminate sources of ignition. Supply maximum ventilation with explosion-proof equipment.

WASTE DISPOSAL METHOD: Relocate leaking containers in a remote downwind area out doors, and allow to vent to atmosphere. Incinerate gas by controlled burning in flare if possible. Follow Federal, State and Local regulations.

SECTION VIII--SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION: Use self-contained breathing apparatus when necessary.

VENTILATION: LOCAL EXHAUST (X) Provide adequate ventilation in sumps, MECHANICAL (GENERAL) (X) confined areas and to meet TWA standards.

PROTECTIVE GLOVES: Rubber or plastic EYE PROTECTION: Safety goggles, safety glasses or face shield.

OTHER PROTECTIVE EQUIPMENT: Safety shoes, eyewash, safety shower and protective clothing if liquid contact potential exists.

SECTION IX--SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Protect cylinders against physical damage. Store in cool, dry, well-ventilated area, away from sources of heat and ignition. Keep away from oxidizers such as oxygen, chlorine and fluorine. Electrical equipment should be explosion-proof. Piping connections and containers should be grounded. Use check valve or trap in discharge line to prevent hazardous back flow. Post "No Smoking" or "Open Flame" signs in storage and use areas. Cylinder temperature should be kept under 130°F.

OTHER PRECAUTIONS: Use only DOT or ASME coded containers. Electrically ground all lines and equipment. Cylinders must not be recharged except by or with consent of Liquid Carbonic. For more information, refer to CGA Bulletin SB-2 "Oxygen Deficient Atmospheres" and CGA Pamphlet P-1 "Safe Handling of Compressed Gases in containers."

No guaranty is made as to the accuracy of any data or statement contained herein. While this material is furnished in good faith, NO WARRANTY EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS OR OTHERWISE IS MADE. This material is offered only for your consideration, investigation and verification and Liquid Carbonic shall not in any event be liable for special, incidental or consequential damages in connection with its publication.

No. 174

## HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES

N/A

## PHYSICAL DATA

BOILING POINT -317.9°F (-194.4°C)	LIQUID DENSITY AT BOILING POINT 54.70 lb/ft <sup>3</sup> (876.21 kg/m <sup>3</sup> )
VAPOR PRESSURE @ 70°F (21.1°C) Above the critical temperature of -220.4°F (-140.2°C)	GAS DENSITY AT 70°F 1 atm .0749 lb/ft <sup>3</sup> (1.200 kg/m <sup>3</sup> )
SOLUBILITY IN WATER @ 68°F (20°C) Bunsen coefficient = .0183	FREEZING POINT N/A; Bubble point @ 1 Atm. = -317.8°F (-194.35°C)
APPEARANCE AND ODOR Colorless gas with possible very slight olefinic odor	

## FIRE AND EXPLOSION HAZARD DATA

FIRE AND EXPLOSION HAZARD DATA		
FLASH POINT (METHOD USED) N/A	AUTO IGNITION TEMPERATURE N/A	FLAMMABLE LIMITS % BY VOLUME N/A
EXTINGUISHING MEDIA Nonflammable gas		ELECTRICAL CLASSIFICATION Nonhazardous
SPECIAL FIRE FIGHTING PROCEDURES  N/A		
UNUSUAL FIRE AND EXPLOSION HAZARDS Compressed air at high pressures will accelerate the burning of materials to a greater rate than they burn at atmospheric pressure.		

## REACTIVITY DATA

STABILITY Unstable	CONDITIONS TO AVOID	
Stable	X	N/A
INCOMPATIBILITY (Materials to avoid)	None	
HAZARDOUS DECOMPOSITION PRODUCTS	None	
HAZARDOUS POLYMERIZATION May Occur	CONDITIONS TO AVOID	
Will Not Occur	X	N/A

## SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED N/A
WASTE DISPOSAL METHOD N/A

## EMERGENCY RESPONSE INFORMATION

IN CASE OF EMERGENCY INVOLVING THIS MATERIAL, CALL DAY OR NIGHT (800) 231-1366  
OR CALL CHEMTREC AT (800) 424-9300

**APPENDIX E**  
**RESPONSE TO COMMENTS**

**Response to Comments  
Fluidized Bed Adsorption PRDA Test  
Work Implementation Plan  
McClellan Air Force Base, IC-31  
Sacramento, California**

Comment	Page	Comment	Agree/ Disagree	Response
COMMENTS OF TIM CHAPMAN, BDM				
1	1	Use McClellan AFB not McAFB in document.	Agree	Text edited to reflect this change.
2	1	Delete "chemical cleanup".	Agree	Text edited to reflect this change.
3	1	delete "caustic cleaners" and "heavy metals".	Agree	Text edited to reflect this change.
4	1	Delete "polychlorinated...radioactive wastes".	Agree	Text edited to reflect this change.
5	1	Change "late 1970s" to "1979".	Agree	Text edited to reflect this change.
6	1	Change "chlorinated hydrocarbons" to "volatile organic compounds".	Agree	Text edited to reflect this change.
7	1	Include that SMAQMD regulations are the driving force for DRE requirements	Agree	Text includes SMAQMD reference as the driving force for DRE requirements.
8	1	Delete "common" and insert "methods <i>currently in use</i> such".	Agree	Text edited to reflect this change.
9	1	Delete ", together...partners,".	Agree	Text edited to reflect this change.
10	3	Change sentence to remove the name of the consultant operating the system and state that a system is operated by McClellan.	Agree	Text indicates that the existing cat-ox system is being operated by McClellan AFB.
11	3	Change "three current or future source at IC-31" to "the following sources:"	Agree	Text edited to reflect this change.
12	3	Delete sentence.	Agree	Text edited to reflect this change.
13	3	Change "equipment...tests" to "technology demonstration projects".	Agree	Text edited to reflect this change.
14	5	Qualify the statement to indicate that the product would "typically" or "should be" suitable for recycling.	Agree	Text indicates the recovered liquid-phase product to be typically suitable for recycling.
15	9	Delete last sentence of paragraph.	Agree	Text edited to reflect this change.
16	12	Delete "both" and "and other...technologies".	Agree	Text edited to reflect this change.
17	14	Need a more firm statement that no further characterization is required prior to the demonstration. Otherwise a justification and contingency plan should be added to determine when it would be required.	Agree	Text replaced with the following statement: "IC-31 has been characterized under a base-wide Remedial Investigation (RI). Operation data from the existing SVE system provides additional characterization that furnishes a strong basis for designing the FBA test. No further site characterization is planned for the scope of work presented in this WIP."
18	14	First sentence. Delete and replace with a reference to plates that will include the drawings provided separate from this work plan.	Agree	Text references plates to be included with final work implementation plan.

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Comment	Page	Comment	Agree/ Disagree	Response
19	14	Delete the first statement. Liquid from the AWS will need to be collected and disposed of accordingly. Depending on the sampling results it may be able to go to the IWL or it may have to be disposed of elsewhere.	Agree	Subject sentence deleted.
20	17	Parenthetically include the volume that this weight of resin represents.	Agree	"(approximately 2.4 to 2.7 cubic feet)" added to the text.
21		In Section 5, the AWS liquid needs to be added as a separate waste stream.	Agree	AWS liquid added as a separate waste stream under a new Section 5.4.3. We will specify that the material will be retained for handling with other AWS liquids generated at the site.
22	18	Delete last sentence.	Agree	Text edited to reflect this change.
23	18	Delete last 2 sentences.	Agree	Text edited to reflect this change.
24	18	Replace last sentence with states that air discharge requirements are met by the current treatment system. Permits per se are not required for CERCLA clean up actions.	Agree	Last sentence replaced with: "The existing CatOx system operates in compliance with SMAQMD requirements and will treat FBA system emissions."
25	18	Insert other compliance regulations such as RCRA, OSHA, CAA, SDWA.	Agree	Other compliance regulations inserted: - RCRA as authorized by the State of California hazardous waste management regulations: California Department of Toxic Substances Control. In particular requirements for generators and transporters of hazardous waste: 22 CCR 66261 through 66263. - Hazardous Material Transportation Regulations: US Department of Transportation. In particular, 49 CFR Parts 171 and 172. - OSHA regulations are cited within the Health and Safety Plan (Appendix B). - California Air Act: Sacramento Metropolitan Air Quality Management District. FBA system test will comply with air quality regulations through the Permit to Operate issued to McAFB, including fugitive emissions requirements, if any. - Safe Drinking Water Act. Does not apply to operations associated with FBA test.
26	21	Should this read "GC/MS"?	Agree	Text edited to reflect this change.
27	27	Need to incorporate the Basewide RI/FS QAPP by reference.	Agree	Text included at the end of Section 8.1 (Introduction and Objectives) to incorporate the Basewide RI/FS QAPP by reference.



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Comment	Page	Comment	Agree/ Disagree	Response
28	27	Need to include information on sample identification and labeling.	Agree	A sample designation section along with its corresponding table added to the work plan
29	Table 3	Change to "Discharge to IWL".	Agree	Text edited to reflect this change.
30	Table 3	AWS should be its own row. Note that it will be collected and disposed of with the IC 31 AWS liquid.	Agree	Table 3 revised with a dedicated row for the AWS liquid.
31	Table 3	Note that the phone will be provided by HLA and not McClellan AFB.	Agree	HLA footnoted Telephone to state: "HLA will coordinate and pay for telephone service for the FBA test."
32	Table 4	Water condensate samples do not total correctly in right-most columns.	Agree	Table 4 revised to reflect the correct total of water condensate samples to be collected.
33	Table 4	The number of TO-14 samples needs to be increased so that they are taken during the process run. At a minimum a third set needs to be included between weeks 3 and 6. Also the low flow samples should be taken on week 9.	Agree	Table 4 revised to include a third set of influent and effluent samples to be collected during Week 5. In addition, Table 4 will indicate that the low influent concentration samples will be collected during Week 9.
34	Table 6	The data quality levels should use standard EPA level I, II, III, etc. Also, these quality levels should be defined in the QAPP text. For example, PID is level I, 8021 should be level II, and TO-14 are usually level III.	Agree	Table 6 cross-references data quality levels ("screening" and "definitive") with corresponding RI QAPP designations of EPA level I, II, III.
35	Table 7	Need to reference RI QAPP tables. Also, the values shown are not in agreement with those in the RI QAPP. Deviations from the requirements of the RI QAPP require detailed explanation and justification.	Agree	Table 7 modified to reference values presented in the RI QAPP.
36	Table 8	Does not include out of temperature conditions (e.g., liquid samples received at greater than 4°C).	Agree	Data validation procedures modified to include handling protocol for samples received out of temperature conditions.
37	Plate 2	Sampling ports should be noted on this drawing using their unique identifiers. This plate should be replaced with detailed 3 sheet drawings.	Agree	Revised plate includes unique sampling port identifiers. Additional instrumentation, equipment, and one-line plates submitted with the work plan.
38	Plate 3	Need to indicate independence of QA officer and show QA manager.	Agree	The Program QA role of Mr. Chris Smith retitled QA Officer and identified and redefined in the text. The position is an independent role and will be specified as such in the final work implementation plan.

**Response to Comments  
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Comment	Page	Comment	Agree/ Disagree	Response
39	B-2	Delete reference to SO <sub>2</sub> sampling.	Agree	Text will be edited to reflect this change.
40	B-6	Only 24-h training is required for this demonstration (this is a well characterized site and the driving force is RCRA for the solvent). Note that you are requiring 40-h training and rephrase regulatory reference appropriately.	Agree	HLA safety policies require 40-hr training for employees working on CERCLA cleanup projects as defined by the WIP Section 3.1.1 as "Regular Site Personnel". The WIP provides for non-HLA employees, identified in Section 3.1.2 as "Occasional Site Personnel", only require 24-hr training.
41	B-11	Part of cat-ox treatment system is under positive pressure.	Agree	Text edited to indicate that part of cat-ox system is under positive pressure.
42	HASP	Need to add requirement for routine PID readings during system operations to check for developing leaks in process piping.	Agree	Text indicates that PID readings along process piping will be collected during site visits to check for fugitive emissions
43	B-13	MSDSs are to be provided to SM-ALC/EMP who will forward them to the appropriate base agencies.	Agree	MSDSs provided to SM-ALC/EMP as attachments to the WIP. Should additional MSDS information be identified for the project after issuance of the WIP, the MSDS will be sent to SM-ALC/EMP independently.
44	B-16	The steel scaffolding reference is not appropriate and should be deleted. You will not be accessing the stack for sampling.	Agree	Steel scaffolding access reference deleted from the HASP.
45	B-17	In second sentence typo "120V".	Agree	Text edited to correct typo.
46	B-18	Typo double period.	Agree	Text edited to correct typo.
47	B-18	Portions of the IC-31 treatment pad are considered a hard hat area by McClellan AFB.	Agree	Text edited to indicate that IC-31 is considered hard hat area by McClellan AFB.
48	B-21	McClellan AFB, California EPA, U.S. EPA, other regulatory agencies, and their representatives are allowed on the test pad.	Agree	Text edited to indicate that McClellan AFB, California and U. S. EPA, and other regulatory agencies are allowed on the test pad.
49	B-21	You cannot direct that another organization's H&S officer will be responsible for this action. You are responsible for proper handling of wastes until they are transferred to another contractor or system. You can reference that other organizations are responsible for wastes and materials under their cognizance.	Agree	The words "SVE CatOX" deleted from text.
50	B-23	Typo, hospital map is plate 2	Agree	Text edited to reflect this change.
51	HASP	A map to the base clinic is not included as required.	Agree	A map indicating the route to McClellan AFB clinic included in the HASP

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Comment	Page	Comment	Agree/ Disagree	Response
52	Table 3	The McClellan AFB Remedial Program Manager is Ms. Elaine Anderson, 643-0830 x 146.	Agree	Table edited to reflect this change.
53	HASP	As part of the maps to emergency medical facilities, driving instructions should be included.	Agree	Driving instruction from IC-31 area to the base clinic and off-base hospital included in the HASP.
54		Please print final work plan in duplex (2 sided) copies.	Agree	Final work plan printed in duplex (2 sided) format.

**COMMENTS OF ED MARCHAND, AFCEE**

1		The title of the document is inaccurate. Fluidized bed implies a certain particle path within the reactor. Please rename the document and refer to the technology differently.	Agree/ Answer	A statement added to the first reference of FBA in the text (Page 1, line 1) with qualification language stating that the name "fluidized bed" is used by the vendor for this equipment in published literature. HLA stipulated that the use of the term "fluidized bed" is strictly as a trade name for the technology and is not intended to imply a certain particle path within the reactor.
2		Experience with Ambersorb 572 (a cousin of Ambersorb 600) has shown a 99.9% mineralization of the contaminants at temperatures of 180°C.	Answer	Certain contaminants strongly bind to Ambersorb resin. However, most chlorinated VOCs are removed from the resin rather than mineralized when heat is applied. Sampling and analyses of resin beads was specified in the test plan to monitor whether non-chlorinated constituents in the process stream at IC-31 may irreversibly bind to the resin at temperatures achieved by the desorber.

**COMMENTS OF ALEXANDER MACDONALD, SV-RWQCB**

1	7	Do the high boilers include fuels? If so, will the proposed modifications account for the high concentrations of fuels at IC-31?	Answer	To account for the fuel constituents observed at IC-31, the FBA Test Unit has been modified with a hot-oil heat source for desorbing VOCs from the resin beads. Sampling and analyses of resin beads at intervals during the test is specified in the test plan to monitor whether any high-boiling fuel constituents accumulate on the resin.
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Comment	Page	Comment	Agree/ Disagree	Response
2	11	The concentration of NOx is proposed to be determined from a single sample from the emissions test. Is a single sample sufficient to determine the NOx production from the treatment system? Will the sampling for NOx be done during a high or low influent contaminant concentration period?	Answer	A single NOx test has been planned during the high influent concentration operating period. Because FBA does not oxidize VOCs, no NOx is generated; one sample has been planned to confirm that NOx is not present.
3	14	What is the capacity of the secondary containment to be provided for the non-cooling water liquids?	Answer	The following italicized language was added to the sentence ending on Page 14, line 22: "All vessels containing non-cooling water liquids will be installed within secondary containment <i>with a minimum capacity of 110% of the primary containment vessels.</i> "
4	21	It is stated that only a mobile laboratory can be used for determining NOx concentrations in samples collected from the treatment unit. How are McClellan's existing SVE systems monitored for NOx emissions? If a mobile laboratory unit is available for NOx analyses on samples from the other SVE units, it could be used for this treatability study. If there is no mobile unit, is the method for NOx sampling and analyses acceptable or is a fixed laboratory sufficient?	Answer	The McClellan work plan for operating the existing CatOx system references test method CARB-100 for NOx testing. This method requires onsite analyses capabilities due to the rapid degradation rate of NOx. A mobile laboratory certified for conducting CARB-100 will be retained to analyze NOx from the FBA Test Unit during a period of high influent concentrations.

## **DISTRIBUTION**

Final Work Implementation Plan  
PRDA Test: "Fluidized Bed Adsorption"  
McClellan Air Force Base, Site IC 31  
Sacramento, California

June 30, 1997

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Quality Control Reviewer



David Hochmuth, P.E.  
Associate Engineer

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